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CHARLES F. MARVIN, Chief

MONTHLY WEATHER REVIEW

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NOTICE TO CONTRIBUTORS.

Contributions intended for publication in any given issue of the MONTHLY WEATHER REVIEW (e. g., January) should be in the hands of the editor before the end of the next following month (e. g., February), if no illustrations are required. When the paper is illustrated, the manuscript and the copy for illustrations must be submitted much earlier, in order to permit copy being prepared for the engraver by the end of the month.

REPRINTS are made up without covers in the original size and pagination of the REVIEW. They will not be furnished unless specificallly REQUESTED WHEN THE MANUSCRIPT IS SUBMITTED.

MONTHLY WEATHER REVIEW

HERBERT H. KIMBALL, Acting Editor.

VOL. 46, NO. 5.
W. B. NO. 648.

MAY, 1918.

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INTRODUCTION.

As explained in this Introduction during 1914, the MONTHLY WEATHER REVIEW now takes the place of the Bulletin of the Mount Weather Observatory and of the voluminous publication of the climatological service of the Weather Bureau. The MONTHLY WEATHER REVIEW contains contributions from the research staff of the Weather Bureau and also special contributions of a general character in any branch of meteorology and climatology.

SUPPLEMENTS to the MONTHLY WEATHER REVIEW are published from time to time.

The climatological service of the Weather Bureau is maintained in all its essential features, but its publications, so far as they relate to purely local conditions, are incorporated in the monthly reports "Climatological Data" for the respective States, Territories, and colonies. These are listed on p. 3 of the cover.

Since August, 1915, the material for the MONTHLY WEATHER REVIEW has been prepared and classified in accordance with the following sections:

SECTION 1.—*Aerology.*—Data and discussions relative to the free atmosphere.

SECTION 2.—*General meteorology.*—Special contributions by any competent student bearing on any branch of meteorology and climatology, theoretical or otherwise.

SECTION 3.—*Forecasts and general conditions of the atmosphere.*

SECTION 4.—*Rivers and floods.*

SECTION 5.—*Seismology.*—Results of observations by Weather Bureau observers and others as reported to the Washington office.

SECTION 6.—*Bibliography.*—Recent additions to the Weather Bureau library; recent papers bearing on meteorology.

SECTION 7.—*Weather of the month.*—Summary of local weather conditions; climatological data from regular Weather Bureau stations; tables of accumulated and excessive precipitation; data furnished by the Canadian Meteorological Service; monthly charts Nos. 1, 2, 3, 4, 5, 6, 7, 8, the same as hitherto; Meteorological Summary and chart No. 9 of the North Atlantic Ocean for this month in 1917. Owing to the fact that ocean meteorological data are frequently not available for a considerable time after the close of the month to which they relate, the chart and text matter in connection therewith appear one year late.

In general, appropriate officials prepare the seven sections above enumerated; but *all students of atmospherics are cordially invited to contribute such additional articles as seem to be of value.*

The voluminous tables of data and text relative to local climatological conditions, that during recent years were prepared by the 12 respective "district editors," are omitted from the MONTHLY WEATHER REVIEW, but are collected and published by States at selected section centers. (See cover, p. 3.)

The data needed in Section 7 can not be collected and prepared until several weeks after the close of the month designated on the title-page; hence the REVIEW as a whole can not issue from the press until about eight weeks from the end of that month.

It is hoped that the meteorological data hitherto contributed by numerous independent services will continue as in the past. Our thanks are specially due to the directors and superintendents of the following:

The Meteorological Service of the Dominion of Canada.
The Meteorological Service of Cuba.
The Meteorological Observatory of Belen College, Habana.
The Government Meteorological Office of Jamaica.
The Meteorological Service of the Azores.
The Meteorological Office, London.
The Danish Meteorological Institute.
The Physical Central Observatory, Petrograd.
The Philippine Weather Bureau.

The Weather Bureau desires that the MONTHLY WEATHER REVIEW shall be a medium of publication for contributions within its field, but such publication is not to be construed as official approval of the views expressed.

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SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING MAY, 1918.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Weather Bureau, Washington, D. C., June 28, 1918.]

For a description of instrumental exposures and an account of the methods of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1918, **46**:2.

The monthly means and departures in Table 1 show that at all four stations direct solar radiation intensities differed but slightly from the normal intensities for May.

Table 3 shows an excess of about 7 per cent in the total radiation at Lincoln, Nebr., as compared with the normal amount for May, and only unimportant departures at Washington and Madison, Wis.

Skylight polarization measurements obtained at Washington on 6 days give a mean of 53 per cent with a maximum of 59 per cent on the 11th. These are about average values for Washington in May. Measurements obtained at Madison on 5 days give a mean of 59 per cent with a maximum of 65 per cent on the 1st.

TABLE 1.—*Solar radiation intensities during May, 1918.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
1918.										
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
May 1	.....	.....	0.84	0.64	0.49	.....	.....	.....	.....	.....
2	.....	1.14	1.09	1.00	0.92	0.84	0.78	0.72	0.67	.....
6	1.20	1.03	0.88	0.78	.....	.....	.....	.....	.....	.....
8	1.30	.....	0.97	.....	.....	.....	.....	.....	.....	.....
9	.....	1.12	1.04	0.94	0.87	0.81	.....	.....	.....	.....
11	1.24	1.21	1.14	1.04	0.95	0.88	0.79	0.72	0.67	.....
17	1.21	1.09	0.98	0.86	0.79	0.72	0.66	.....	.....	.....
18	1.29	1.17	1.06	0.96	0.88	0.81	0.74	.....	.....	.....
29	.....	0.70	0.60	.....	.....	.....	.....	.....	.....	.....
Monthly means	**1.25**	**1.07**	**0.96**	**0.89**	**0.82**	**0.81**	**0.74**	**(0.72)**	**(0.67)**	.....
Departure from 10-year normal	**−0.04**	**−0.04**	**−0.01**	**±0.00**	**+0.04**	**+0.09**	**+0.04**	**+0.14**	**+0.13**	.....
P. M.										
May 2	.....	1.29	1.05	0.95	0.87	.081	0.74	0.67	0.61	.....
17	.....	1.13	0.98	0.89	0.82	0.75	0.69	0.64	0.59	.....
18	.....	1.19	.....	.....	.....	.....	.....	.....	.....	.....
Monthly Means	.....	**1.20**	**(1.02)**	**(0.92)**	**(0.84)**	**(0.78)**	**(0.72)**	**(0.66)**	**(0.60)**	.....
Departure from 10-year normal	.....	**+0.07**	**+0.04**	**+0.08**	**+0.05**	**+0.04**	**−0.01**	**+0.01**	**−0.02**	.....

TABLE 1.—*Solar radiation intensities during May, 1918*—Continued.

[Gram-calories per minute per square centimeter of normal surface.]

Madison, Wis.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
1918.										
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
May 1	1.44	1.36	1.24	1.12	.....	.....	.....	.....	.....	.....
2	1.28	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.49	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	1.38	1.31	1.18	1.02	0.88	.....	.....	.....	.....	.....
14	1.30	1.25	1.17	1.10	1.03	0.96	.....	0.85	.....	.....
16	.....	.....	1.03	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	1.17	1.11	1.06	.....	.....	.....	.....	.....
Monthly means	**1.38**	**1.31**	**1.16**	**1.09**	**0.99**	**(0.96)**	.....	**(0.85)**	.....	.....
Departure from 8-year normal	**+0.05**	**+0.10**	**+0.07**	**+0.11**	**+0.06**	**+0.07**	.....	.....	.....	.....
P. M.										
May 1	.....	.....	.....	1.04	0.97	.....	.....	.....	.....	.....
2	.....	1.12	0.94	.....	.....	.....	.....	.....	.....	.....
10	.....	1.36	.....	.....	.....	.....	.....	.....	.....	.....
13	.....	1.35	.....	.....	.....	.....	.....	.....	.....	.....
Monthly means	.....	**1.28**	**(0.94)**	**(1.04)**	**(0.97)**	.....	.....	.....	.....	.....
Departure from 8-year normal	.....	**+0.06**	**−0.04**	**+0.10**	.....	.....	.....	.....	.....	.....

Lincoln, Nebr.

A. M.										
May 1	1.39	1.30	1.21	1.11	1.01	0.92	0.85	0.80	0.77	.....
3	1.37	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.40	1.21	1.10	1.00	0.92	0.84	0.76	.....	.....	.....
14	.....	1.15	1.05	0.97	0.84	0.78	0.70	0.63	.....	.....
19	1.35	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	1.30	.....	.....	.....	0.69	.....	.....	.....	.....	.....
Monthly means	**1.36**	**1.22**	**1.12**	**1.03**	**0.86**	**0.85**	**0.77**	**(0.72)**	**(0.77)**	.....
Departure from 3-year normal	**+0.01**	**−0.04**	**−0.04**	**−0.01**	**−0.09**	**−0.03**	**−0.05**	**−0.06**	**−0.05**	.....
P. M.										
May 1	.....	1.19	1.06	0.96	0.87	0.78	0.71	0.63	0.57	.....
3	.....	1.25	1.14	1.04	0.91	0.83	0.77	0.71	0.67	.....
19	.....	1.17	.....	.....	.....	.....	.....	.....	.....	.....
Monthly means	.....	**1.28**	**(1.10)**	**(1.00)**	**(0.89)**	**(0.80)**	**(0.74)**	**(0.67)**	**(0.62)**	.....
Departure from 3-year normal	.....	**+0.06**	**+0.10**	**+0.10**	**+0.08**	**+0.07**	**+0.06**	**−0.08**	**−0.07**	.....

Santa Fe, N. Mex.

A. M.										
May 21	.....	1.37	1.26	1.20	1.15	.....	.....	.....	.....	.....
23	.....	.....	.....	.....	1.07	1.02	.....	.....	.....	.....
28	1.48	.....	1.24	.....	.....	.....	.....	.....	.....	.....
31	.....	1.33	1.19	1.13	.....	.....	.....	.....	.....	.....
Monthly means	**(1.48)**	**(1.35)**	**1.23**	**(1.16)**	**(1.11)**	**(1.02)**	.....	.....	.....	.....
Departure from 6-year normal	**−0.04**	**−0.04**	**−0.06**	**−0.06**	**−0.06**	**−0.10**	.....	.....	.....	.....
P. M.										
May 31	.....	.....	1.22	.....	1.12	.....	.....	.....	.....	.....
Monthly means	.....	.....	**(1.22)**	.....	**(1.12)**	.....	.....	.....	.....	.....
Departure from 2-year normal	.....	.....	**+0.12**	.....	.....	.....	.....	.....	.....	.....

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.
1918.	*mm.*	*mm.*	1918.	*mm.*	*mm.*	1918.	*mm.*	*mm.*	1918.	*mm.*	*mm.*
May 1	6.27	5.16	May 1	4.57	6.27	May 1	3.99	6.02	May21	3.45	3.63
2	4.17	4.37	2	6.02	9.14	3	6.50	7.04	23	4.57	3.63
6	10.21	11.38	10	4.95	3.99	4	9.83	9.83	28	2.87	2.26
8	11.81	6.02	13	4.17	3.63	14	6.50	6.50	31	2.36	4.57
9	6.27	10.59	14	3.99	6.27	19	13.13	6.27	.....	.....	.....
11	7.04	8.81	16	10.59	9.14	21	13.61	14.10	.....	.....	.....
17	10.59	7.04	20	6.27	6.50	.....	.....	.....	.....	.....	.....
18	12.24	14.60	.....	.....	.....	.....	.....	.....	.....	.....	.....
29	15.65	10.97	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 3.—*Daily totals and departures of solar and sky radiation during May, 1918.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.			Excess or deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
1918.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
May 1	422	703	697	−48	249	234	−48	249	234
2	656	640	666	183	185	201	135	434	435
3	415	626	687	−62	170	220	73	604	655
4	264	536	642	−216	79	173	−143	683	828
5	567	573	433	84	115	−38	−59	798	790
6	582	195	573	97	−264	100	38	534	890
7	390	378	570	−97	−82	95	−59	452	985
8	612	381	628	123	−80	151	64	372	1,136
9	570	223	536	80	−239	57	144	133	1,193
10	515	683	693	23	220	212	167	353	1,405
11	649	246	654	155	−218	171	322	135	1,576
12	569	263	515	73	−202	30	395	−67	1,606
13	352	670	632	−146	204	145	249	137	1,751
14	379	691	584	−120	225	95	129	362	1,846
15	508	625	656	8	158	165	137	520	2,011
16	567	657	638	67	190	145	204	710	2,156
17	662	419	322	162	−48	−173	366	662	1,983
18	664	567	610	164	99	113	530	761	2,096
19	508	248	686	8	−220	187	538	541	2,283
20	563	664	650	63	196	149	601	737	2,432
Decade departure							**434**	**384**	**1,027**
21	462	352	592	−38	−116	89	563	621	2,521
22	589	580	428	89	112	−77	652	733	2,444
23	458	624	270	−42	155	−237	610	888	2,207
24	376	224	529	−123	−245	20	487	643	2,227
25	383	346	495	−116	−123	−15	371	520	2,212
26	537	554	182	39	84	−330	410	604	1,882
27	493	199	184	−5	−272	−330	405	332	1,552
28	508	196	245	11	−276	−271	416	56	1,281
29	564	102	464	68	−371	−54	484	−315	1,227
30	153	420	498	−342	−54	−22	−142	−369	1,205
31	403	609	401	−91	134	−121	51	−235	1,084
Decade departure							**−550**	**−972**	**−1,348**
Excess or deficiency since first of year							**−944**	**+630**	**+505**
							−1.9	**+1.3**	**+0.9**

CONSTANT σ IN THE STEFAN-BOLTZMANN LAW.[1]

By M[ARYA] KAHANOWICZ.

[*Reprinted from* Science Abstracts, Sect. A, Mar. 31, 1918, § 288.]

In Stefan's Law the energy exchanged between two elements of area of black bodies at absolute temperatures T and T_0 is expressed by the formula

$$\sigma\, k\, (T^4 - T_0^4),$$

where k is a geometrical coefficient depending on the form of the elements, their dimensions and their distance apart, and σ is the Stefan constant to be determined. A critical résumé and discussion follows of the methods of the investigators named below:

Kurlbaum, bolometer.....σ=5.32, or corrected for reflection, 5.45.
Scheiner, Ångström pyrheliometer.4.73.
Féry, conical receiver.....6.3 and 6.3.
Bauer and Moulin, Ångström pyrheliometer.....5.7.
Valentiner, Kurlbaum bolometer...5.38 and 5.58.
Féry and Drecq, thermometer.....6.51.
Gerlach, Paschen receiver.....5.803 and 5.9.
Puccianti, bolometer.....5.96 and 5.96.
Puccianti, thermometer.....6.15.
Keene, thermometer.....5.89.
Coblentz, modified Paschen receiver.....[a]5.65 and 5.79.
Kahanowicz, modified Amerio receiver.....5.60, or corrected for reflection, 5.61.

The author gives the above result of her own new determination.—*A. D[aniell].*

[1] *See* Nuovo cimento, Feb.-Mar., 1917, **13**: 142-167.

HALO OBSERVATIONS AT YORK, N. Y., 1917.

Our cooperative observer at York, N. Y., Mr. Milroy N. Stewart, writing to correct a few misapprehensions incorporated in the article on page 119 of this REVIEW for March, 1918, states:

The average interval between halo and precipitation which you give [loc. cit.] as 17.3 hours is true for the lunar halos which I did not use at all in Table 2 [of the REVIEW, Sept. 1915, p. 444]. For 317 solar halos the interval was 20.4 hours. I have never paid much attention to results from the lunar halos because nearly all are seen between 8 and 11 p. m. and then only near the full moon.

My total observations were 325 solar + 64 lunar=389, halos. There was a maximum in March of 5.4 solar, or of 6.7 solar + lunar halos. The minimum was not in June; for solar alone it was 2.3 in December, and for both it was 3.9 in August.

[These corrections to Mr. Martin's paper in the March issue are not important to his conclusions; but are published here to correct the quotation from Stewart's tables.]

For 1917 Mr. Stewart finds the following results of his observations at York, N. Y.

Relation of halos to subsequent precipitation, York, N. Y., 1917.

Class of halo.	Total.	Mean interval to precipitation.	Precipitation next day.	Precipitation on second day.	No precipitation in 48 hours.
	1	2	3	4	5
Solar	83	(a) 20.8 hrs.	28	48	9
Lunar	12	(b) 12.8 hrs.	9	.....	3
Both	95	.....	37	48	12
Mean	.....	(c) 19.8 hrs.	.....	.....	.....

(c) = ⅛ (7a + b).

There is duplication in columns 3 and 4, and no account was taken of precipitation occurring the same day as the halo.

[a] The value preferred by Coblentz and adopted for radiation work in the Weather Bureau, is $\sigma = 5.7 \times 10^{-12}$ watt per sq. cm. per deg.^{4}. *See* Bull. U. S. Bur. Standards, Washington, 1916, **13**: 470—EDITOR.

WEATHER BUREAU AN AID TO AVIATION AND ARTILLERY SERVICES.

[*Reprinted from* Department of Agriculture Weekly News Letter, June 12, 1918.]

In cooperation with the Signal Corps, United States Army, the Weather Bureau is providing and maintaining for the duration of the war aerological and meteorological observations at a number of aviation and artillery fields. For use at these fields tables [1] of mean values of atmospheric pressure, temperature, and density, and a paper on "Meteorology and Aeronautics" have been published.[2]

In connection with searchlight tests conducted in February and March at Washington by the Engineer Corps of the Army, the Weather Bureau made some kite flights at night. Other flights were made in daylight in connection with studies of atmospheric electricity conducted by the Bureau of Standards.

CLIMATOLOGY AND AN ABANDONED FLYING SCHOOL.

[*Reprinted from* Nature, London, May 30, 1918, 101: 247-248.]

The "Times" of May 20 contains a summary of the third report of the Select Committee on National Expenditure, which gives the material facts about the abortive scheme of the War Office to establish at Lock Doon, Ayrshire, a large school for the training of airmen in gunnery. It is a striking and very expensive example of that incoherence or lack of coordination under stress against which the discipline of science as a part of education should be our safeguard. In 1916 the Air Board wanted an aerodrome for special purposes, and found a site at Loch Doon which would fulfil their requirements provided that a peat-bog on the western side of the lake could be drained and certain engineering work carried out on the eastern side. Taken independently, both these conditions could be satisfied, and operations were set on foot. By May, 1917, the estimated cost was £350,000; afterwards, large further sums were being asked for to complete the scheme; but, though each item had been separately satisfied, the object was not achieved. The climatic conditions were quite unsuitable for a training school, the local "bumps" were a great drawback for the special purpose of the aerodrome, the conditions of the surrounding area placed intolerable restrictions upon its use, and on account of the increased speed of flight the engineering works were already out of date. In January, 1918, the Air Council decided to cut the loss and abandon the scheme.

Looking back at the evolution of this fiasco, various points are evident. The air authorities apparently worked by the map, the engineers considered only the questions of draining a bog and constructing certain railways, hangars, etc., not the making of an aerodrome; and the vexatious details of the climate of the British Isles were left to express themselves in their own inexorable way when the mechanical operations had been provided for. The last is, perhaps, the most instructive feature of the situation. Climatology is the science which uses the common experience of past weather to safeguard the future of all operations that depend upon weather. Its basis of fact is merely organized public memory. The Meteorological Committee, in its reports, has frequently urged that, in the public interest, local authorities should keep suitable records. If this course had been followed in Ayrshire, some £500,000 might have been saved. But our local authorities have not yet acknowledged the duty.

It has been left to the meteorological societies, or the Meteorological Office, or the British Rainfall Organization to collect such observations of weather as are made for country landowners or by meteorological enthusiasts in various localities; the distribution is naturally haphazard. Moreover, with the possible exception of the water engineer, the people who have to carry out such schemes have no training in the use of the collected information or in how to find it, and without some experience the tables are difficult to use. Much of the information requires reworking in order to answer special questions. For those who know where to look for it, there is a vast mine of information about the climatology of the British Isles, but it is largely unworked for lack of schools devoted to such sciences. An authoritative compilation is much needed. The Royal Meteorological Society, in cooperation with the Meteorological Office, began to work the data for a climatological atlas shortly before the war, but has had to dicontinue the task for the present. It was thought at the time to be an undertaking of great utility, but that its "present worth" might run to six figures in a single case was clearly not realized.

SOVEREIGNTY OF THE AIR AND ITS RELATION TO CIVIL AERIAL TRANSPORT.

[*Reprinted from* Nature, London, May 9, 1918, 101:191.]

An interesting article appears in the Fortnightly Review for May under the combined authorship of Mr. Claude Grahame-White and Mr. Harry Harper. The title is "Sovereignty of the air and its relation to civil aerial transport," and the authors discuss the conditions which should be adopted for the regulation of air traffic after the war. Three plans are considered—the air may be completely free to all; it may be under the sovereignty of the country over which it lies; or a combination of these is possible by making the air free to all only above a specified altitude. It is pointed out that if war could be abolished by international consent, a free air would be the best solution. It is, however, fairly obvious that, for at any rate some years after the declaration of peace, the nations will be forced to take strong defensive measures in the air, and the only solution of the problem rendering this possible is a complete sovereignty of the air. The authors are of the opinion that commercial aeronautics will make great advances in the near future, and that the rapid intercommunication possible by the use of aircraft will do much to foster the development of friendly sentiments among the nations, and so to advance progress toward the goal of universal peace. They suggest also the desirability of a universal language to facilitate international relations in general, and this is certainly a point which can not be overlooked. The whole question of international relations after the war is one of absorbing interest, and the article under discussion is worthy of perusal by those whose thoughts turn to the aeronautical side of such relations.

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[1] *See* this REVIEW, January, 1918.

[2] National Advisory Committee for Aeronautics. Report No. 13. "Meteorology and aeronautics, by *W. R. Blair.*" Washington, 1917. 50 p. 8°.

DIURNAL VARIATION OF WIND WITH HEIGHT [IN FRANCE].[1]

By L. DUNOYER and G. REBOUL.

[*Reprinted from* Science Abstracts, Sect. A, Mar. 31, 1918, §234.]

Results of observations of pilot balloons in France, carried out at all hours of the day and night, show that at heights of from 200 m. to 800 m. the diurnal variation of wind velocity shows a pronounced maximum during the night, especially when the surface wind is light and coming from the east. The effect is masked by the influence of depressions; and it is therefore not well shown in westerly winds.—*R. C[orless]*.

PHENOMENA CONNECTED WITH TURBULENCE IN THE LOWER ATMOSPHERE.[2]

By G. I. TAYLOR.

[*Reprinted from* Science Abstracts, Sect. A, Mar. 31, 1918, §237.]

The power possessed by the air, in virtue of its turbulence, of transmitting heat and momentum may be represented by the symbol K, where K is proportional to the vertical velocity in the eddies and to the scale of the turbulence. A definition of K has been given in an earlier paper (Sci. Abstr. 1915, §536), and its value was there found to be 0.3×10^4 in CGS units, this figure being obtained from measurements of the change of temperature with height over the sea under conditions in which the turbulence would be very small. Greater turbulence would naturally be expected over the land, and the value of K for the neighborhood of Paris is now worked out from figures which give the diurnal variation of temperature at different heights on the Eiffel Tower. The mean value for the year is found to be 10×10^4, very much larger than that over the sea. There appears to be no indication of an annual variation close to the ground, but K decreases with height in winter and increases with height in summer. This is ascribed to the more nearly adiabatic temperature gradient which occurs in summer—a condition favorable to the development of large values of K. The value close to the ground is nearly independent of the temperature gradient and is governed almost entirely by the wind velocity.

With a given gradient-wind the wind at levels down to the ground will be dependent on the value of K. Assuming a uniform fluctuation of K from a maximum at midday to a minimum at midnight, the form of the diurnal variation of wind velocity is calculated for different heights, and it is found that near the ground the velocity will show a maximum at midday and a minimum at night. At a certain distance up there will be two equal maxima, at midday and midnight with minima between, and at a still greater height a maximum at midnight and a minimum at midday. Some recent experiments on the diurnal variation of wind velocity at different heights by Hellmann [3] have shown that these conditions do actually exist. Further, if values of K based on the Eiffel Tower temperature observations are used reasonably, good quantitative agreement is found between the height at which the type of diurnal variation of velocity should change from one form to the other as deduced by Taylor's theory, and that at which it actually does change. This agreement provides strong confirmation for the idea that both heat and momentum are conveyed through the air by the same agency, viz, eddy conductivity.

This theory to explain the diurnal variation of wind velocity in the lower layers seems more satisfactory than that put forward some time ago by Espy and by Köppen, which fails to account for the results found by Hellmann.—*J. S. Di[nes]*.

[1] *See* Comptes Rendus, Dec. 24, 1917, **165**:1068–1071.
[2] *See* Proc., Royal soc., London, Jan. 1, 1918, **94**:137–155.
[3] Abstract reprinted in this REVIEW, September, 1917, **45**: 454–455.

NITROGEN, CHLORINE, AND SULPHATES IN RAIN AND SNOW.[1]

By E. L. PECK.

[*Reprinted from* Science Abstracts, Sect. A, Mar. 31, 1918, § 239.]

Continuing the observations by Artis at Cornell College, the author deals with 33 precipitations (15.86 inches) of rain and 8 precipitations (22 inches) of snow (equivalent to 17 inches of rain) in the period October 20, 1916, to June 8, 1917. The substances determined are—

	Parts per million per precipitation.	
Sulphate	4.0	to 37.0
Nitrate	0.1	to 0.35
Nitrite	0.0005	to 0.2
Nitrogen, in free ammonia		0.87
Nitrogen, albuminoid ammonia		0.388
Chlorine	2.84	to 18.62

The chlorine content was the most constant, being 7.1 parts for 20 cases.—*H. B[orns]*.

ACOUSTICS OF THE ATMOSPHERE.[2]

By E. SCHRÖDINGER.

[*Reprinted from* Science Abstracts, Sect. A, Feb. 28, 1918, § 181.]

A mathematical treatment of sound propagation in an ideal atmosphere. Plane waves are first considered proceeding vertically, in an isothermal and still atmosphere, with the usual barometric formula. It is thus shown that the amplitude varies inversely as the square root of the density. General wave motion is then dealt with, and it is here shown that the decrease of density above is exactly compensated by increase of amplitude, so that the radiation of energy proceeds as in a homogeneous medium. The influences of temperature gradient and chemical composition are next considered. Finally the attenuation of the sound due to viscosity is treated, the results being shown by graphs. (See Abstract 458 of 1916)—*E. H. B[arton]*.

MEASUREMENTS OF ATMOSPHERIC ELECTRICITY ON TENERIFFE.[3]

By W. BUCHHEIM and H. DEMBER.

[*Reprinted from* Science Abstracts, Sect. A, Feb. 28, 1918, § 189.]

Positive ionization in the air over the Peak of Teneriffe shows a maximum two to three hours after midday. This result is independent of the relative humidity, and it is therefore presumed that ultra-violet light or some other ionizing agent is the cause of the ionization.

The dry gases issuing from blowholes of the crater on the peak are found to possess an ionic density which is ten times that of the free air in the neighborhood. (See Abstract 1075 of 1912.)—*R. C(orless)*.

[1] *See* Chem. News, Dec. 14, 1917, **116**: 283–284.
[2] *See* Physikal. Ztschr., Oct. 1, 1917, **18**: 445–453.
[3] *See* K. Sächs. Gesell. Wiss., Leipzig, Dec. 1915, **67**; *also extract* Ann. d. Physik, Oct. 26, 1917, **53**, 10: 138–150.

DIURNAL VARIATION OF ATMOSPHERIC ELECTRIC POTENTIAL IN CLEAR WEATHER.[1]

By A. B. CHAUVEAU.

[*Reprinted from* Science Abstracts, Sec. A, Feb. 28, 1918, § 190.]

The normal diurnal variation at a point near the ground shows a double oscillation with two minima, one in the afternoon, the other toward the end of the night; and two maxima, the first of which occurs some hours after sunrise and the second soon after sunset. At a sufficient height and also in winter at low altitudes, the variation tends to become simple by the disappearance of the afternoon minimum. Thus it may be inferred that the true law of the variation is given by a simple oscillation, with maximum in the day and minimum in the night, and that at low stations this law is complicated by the disturbing effect of high temperature in the day or one of its concomitants, e. g., increased evaporation, solar radiation, and dryness. The following general explanation of these phenomena depends, as regards the law, on displacements of positive ions or particles charged positively, of atmospheric origin; and as regards the disturbing effect, on displacements of negative ions emanating from the ground.

The earth is charged negatively, and hence there is by induction an excess of positive ions and particles in the lower layers of the atmosphere. Every cause of increase in the number of heavy particles, such as increased humidity, will result in an increase of the excess of positive ions near the ground, with consequent diminution of electrical potential. Thus is explained the minimum in the early morning. The maximum of the day, according to the law, is explained by the upward convective current carrying aloft the heavy positive ions and particles.

Similar reasoning will explain the disturbing effects already referred to, if we replace positive ions by negative ions from the ground. These may be imparted to the air by (1) evaporation, (2) photoelectric action of solar radiation, (3) dust. From the fact that the effect is much less marked at the moderate elevation of the summit of the Eiffel Tower it is concluded that dust is probably the most effective agent for the transfer of the negative charges.—*R. C[orless]*.

[1] *See* Comptes Rendus, Paris, Oct. 29, 1917, **165**: 594–597.

A YEAR'S PENETRATING RADIATION ON THE OBIR.[1]

By V. F. HESS and M. KOFLER.

[*Reprin'ed from* Science Abstracts, Sec. A, Mar. 31, 1918. § 274.]

Continuous measurements of "penetrating" radiation were made on the Obir (alt. 2,044 m.) from October, 1913, to November, 1914, partly with one and partly with two Wulf's apparatus simultaneously. Each measurement referred to an interval of time varying from 3 to 10 hours. A definite seasonal variation is shown with a minimum in March–April, and a maximum in July–August. The amplitude of the seasonal variation of the day observations is about twice as great as that of the night observations and is considerably less than Gockel's observations gave at normal altitudes. The radiation is independent of temperature; it shows no regular diurnal variation in winter, but in summer there is a slight maximum at 16^h [2 p. m.]. The mean values for day and night are equal. Precipitation, specially thunder-rain [?], is accompanied by a distinct increase of the radiation.

The variations of the radiation are both absolutely and relatively smaller than at sea level. This appears to show that the portion of penetrating radiation contributed from outside the atmosphere is nearly constant in intensity. This radiation is apparently not due to the sun, as values for day and night are the same. It is probably due to radium and thorium emanations.—*R. C[orless]*.

[1] Berichte, Akad. Wissensch., Wien, Oct., 1917; Physikal. Ztschr., Dec. 15, 1917, **18**: 585–595.

SECTION II.—GENERAL METEOROLOGY.

SOLAR DISTURBANCES AND TERRESTRIAL WEATHER.

By ELLSWORTH HUNTINGTON, Research Associate in Geography.

[Dated: Yale University, New Haven, Conn., Mar. 7, 1918.]

(*Continued from* this REVIEW, April, 1918, p. 177.)

III. FACULÆ AND THE SOLAR CONSTANT COMPARED WITH BAROMETRIC GRADIENTS.

NOTE.—The third and final section of this paper will appear in the next (June) number of the REVIEW.

—EDITOR.

PREDICTING MINIMUM TEMPERATURES IN GRAND VALLEY, COLO.

By ESEK S. NICHOLS, Meteorologist.

[Weather Bureau office, Grand Junction, Colo., April 18, 1918.]

The devising of methods of predicting minimum temperature, particularly in spring, has been the object of several unpublished studies undertaken by the writer since his assignment to the Grand Junction station in the spring of 1911. These investigations, based on local records, have been of much importance locally, because of the use of temperature forecasts in connection with orchard heating in the Grand Valley, in the midst of which Grand Junction is located.

Previous studies by the writer.—The first of these special studies, made in 1911, considered the minimum temperature as a possible function of the dewpoint that had been recorded at the preceding evening observation; but the conclusion was reached that "there is no useful relation between the two meteorological elements considered. This agrees with the results obtained by Cox[1] in the cranberry marshes of Wisconsin. * * * the dewpoint itself is no indication whatever of the ensuing minimum temperature."

The most important of the special studies was the investigation of the relation between the daily maximum temperature and the ensuing minimum temperature. The individual cases were classified according to evening dewpoint and state of weather and wind in the morning. It was found that, for the month of April, at Grand Junction

$$y=\frac{5}{8}x+z$$

where y is the minimum temperature, x is the maximum temperature, and z is a variable whose value depends on the "class" to which the case belongs. The effect of atmospheric moisture in retarding nocturnal cooling is shown by the following equations, which were obtained for cases classified according to evening dewpoints.

Evening dewpoint.	*Equation.*
20° F. or lower.	$y=\frac{5}{8}x-3$.
21° to 30°.	$y=\frac{5}{8}x-1$.
31° to 40°.	$y=\frac{5}{8}x+1\frac{1}{2}$.
Over 40°.	$y=\frac{5}{8}x+2$.

[1] Cox, H. J. Frost and temperature conditions in the cranberry marshes of Wisconsin. (Weather Bureau, Bulletin T.) Page 84.

The effects of state of sky, precipitation, and wind were shown in a similar manner by equations. All equations were plotted on cross-section paper, and have been used with much success in predicting minimum temperature during frost seasons.

Previous method of forecasting for Grand Junction district.—Having determined the probable minimum temperature at Grand Junction, there remains the problem of predicting the temperatures in the orchard districts of the vicinity, where several fruit-district stations have been maintained since 1913. A brief description of the topography of the fruit district, accompanied by an outline map, is contained in my article, "A temperature inversion in the Grand River Valley, Colo."[2] It was at once found:

1. That the relation between the temperature at any one station and that at Grand Junction is variable.

2. That the relations between the temperatures at the different stations on a given date are variable also. These variations accompany different types of pressure distribution and variations in cloudiness, humidity, wind direction and velocity, etc., which must be known or predicted before the temperature forecasts can be made with accuracy.

Hence the method that has been used in forecasting for the fruit district consists of three principal steps:

(*a*) Study of the weather maps and local reports to determine the probable state of the sky, pressure distribution, wind, etc., over the district the following morning.

(*b*) Computation of the probable minimum temperature at Grand Junction, using results obtained under (*a*) and the equations described above.

(*c*) Estimation of the probable minimum temperatures at the substations, using the results obtained under (*a*) and (*b*), and considering topography and individual peculiarities of each substation,

Development of Smith hygrometric formula.—While this method has been very successful, especially in predicting for Grand Junction, it is complicated and requires that the forecaster shall have had long experience in the locality. As substation records for a four-year period have now accumulated, it was intended for the sake of convenience and greater accuracy to compute substation formulæ similar to those used for Grand Junction; but a test of the hygrometric formula developed by Smith shows that it is both accurate and convenient.[3]

In considering the use of the hygrometric formula in predicting minimum temperatures for the Grand Valley stations, it occurred to the writer that the hygrometric conditions observed at Grand Junction must be representative of, or at least related to, those that exist in other parts of the valley. Therefore, it appeared probable that the readings taken at Grand Junction at the regular evening observation (5:40 p. m., local standard time) might be used in computing constants for predicting minimum temperatures at the substations. This

[2] MONTHLY WEATHER REVIEW, November, 1915, 43: 562–563.

[3] Smith, J. Warren, "Predicting minimum temperatures." MONTHLY WEATHER REVIEW, August, 1917, 45:402–407.

work has been successfully completed for the months of March and April, using available records made during the years 1914 to 1917, inclusive.

The first step was the classification of the individual nights according to months, state of sky and wind velocity at Grand Junction in the morning, and pressure distribution. Then correlation coefficients and hygrometric constants were computed, in accordance with the method described in detail by Smith, for each substation for March and April separately, and for each of the following five classes of nights, as far as records were available:

Classification of nights in the Grand River Valley.

Class I. Sky clear; wind velocity less than 10 miles per hour; and with high-pressure area centered over or immediately west or northwest of the district.

Class II. Sky clear; wind less than 10 miles per hour; and with high-pressure area centered immediately east or northeast of the district, i. e., east of the Continental Divide.

Class III. Sky clear; wind velocity 10 miles per hour or more.

Class IV. Sky partly cloudy; wind velocity less than 10 miles per hour.

Class V. Sky partly cloudy; wind velocity 10 miles per hour or more.

Nights during which appreciable precipitation occurred at Grand Junction were omitted. The number of cases falling under Class V during March was insufficient to warrant computations. Hence, nine sets of coefficients and constants have been computed for each station (with exception of cases where records are broken badly). The results for the Grand Valley stations are so promising that I have computed similar factors for the station at Delta, Colo., which is situated entirely outside of the Grand Valley southeast of Grand Junction, at a distance of about 35 miles in a direct line.

The accompanying tables for March and for April give the numerical results obtained. The headings of the columns correspond with those used by J. Warren Smith in his article referred to above; that is, n is the number of cases used, r is the coefficient of correlation, E is the probable error, and a and b are constants of the hygrometric formula,

$$y = a + bR$$

where R is the evening relative humidity and y is the departure of the morning minimum temperature from the evening dewpoint. For convenience the equations have been plotted on cross-section paper, y as ordinates, R as abscissæ (in actual work a very large scale should be used for clearness and accuracy), so that, in making an evening forecast of minimum temperatures it is now necessary merely to determine, by consulting the daily weather map, the class in which the coming night will fall, and then to take from the appropriate graphs the departures of minimum temperatures from the Grand Junction dewpoint. (See figs. 1 to 9.)

It is regretted that observations for the upper Palisade district are badly broken, so that computations for that part of the valley can not yet be made; the Palisade station is located about 1 1/2 mile west of the town of Palisade, and not in the warmest part of the district.

The high value obtained for the correlation coefficient in almost all cases indicates that increased accuracy in forecasting may be expected as a result of the use of the new formula. However, it should not be expected that successes will be as great in actual work as might appear probable from application of the formula to past records, from which the class in which the night belongs can be determined accurately. The forecaster must determine in advance in which of the five classes the night will fall, if any; and it has been found, in the limited use so far made of the formula that greater inaccuracy is likely to result from incorrect classification than from inaccuracy of the formula when correctly applied.

CONCLUSIONS.

We may conclude, from the above study that—

1. The hygrometric formula of J. Warren Smith is applicable, not only to the prediction of minimum temperature at the station where the hygrometric observations are taken, but to the use of such observations in predicting temperatures at stations many miles away.

2. The formula may be used, not only during clear weather, but also for cases when the sky is partly cloudy.

3. The constants of the formula are, in general, different for the several stations, for the several months, and for differences in certain of the meteorological elements.

4. The forecasting of minimum temperatures will not become simply a mechanical routine, because of the skill necessary in placing the coming night in its proper class.

Finally, the writer believes that the applicability of the formula may be extended still further by using hygrometric observations taken before evening, say at noon, and computing a new series of constants. It is planned to undertake this work when opportunity offers.

TABLE 1.—*Relation between the evening dewpoint and humidity at Grand Junction, Colo., and the following morning's minimum temperatures in the Grand River region in March and April, under different classes of general weather conditions.*

CLASS I.—MORNING CONDITIONS=CLEAR; WIND LESS THAN 10 MIS./HR.; HIGH OVER THE DISTRICT.

Stations.	MARCH.						APRIL.					
	n	r	E	*a*	*b*	$-a/b$	n	r	E	*a*	*b*	$-a/b$
Grand Junction	17	−0.683	±0.088	24.7	−0.58	43.0	10	−0.887	±0.045	26.6	−0.50	51.2
Ground Exp. (G. J.)	17	−0.690	0.086	16.4	−0.48	34.2	10	−0.881	0.048	21.3	−0.51	41.8
Fruitvale	17						10	−0.870	0.052	19.7	−0.47	41.9
Palisade	17	−0.711	0.081	18.5	−0.40	46.5	10	−0.858	0.056	22.3	−0.45	49.7
Orchard Mesa							10	−0.876	0.050	22.3	−0.55	40.7
Pomona	17	−0.649	0.095	13.2	−0.43	30.7	10	−0.864	0.054	17.6	−0.46	38.3
Hunter	17	−0.570	0.110	12.2	−0.39	31.5	10	−0.883	0.047	17.6	−0.44	39.9
Fruita	17	−0.642	0.096	13.5	−0.42	31.8	10	−0.847	0.060	17.3	−0.46	37.4
Loma							10	−0.836	0.064	14.1	−0.38	36.9
Delta							10	−0.896	0.042	13.9	−0.38	36.8

CLASS II.—MORNING CONDITIONS=CLEAR; WIND LESS THAN 10 MIS./HR.; HIGH EAST OR NORTHEAST OF DISTRICT (IN APRIL, EAST OF CONTINENTAL DIVIDE).

Grand Junction	11	−0.929	0.029	19.2	−0.32	59.1	12	−0.884	0.042	19.1	−0.29	65.8
Ground Exp. (G. J.)	11	−0.925	0.029	12.4	−0.31	40.0	12	−0.748	0.086	12.7	−0.25	50.9
Fruitvale							12	−0.622	0.119	8.4	−0.18	46.7
Palisade	11	−0.945	0.022	22.6	−0.42	53.9	12	−0.886	0.042	21.4	−0.32	67.3
Orchard Mesa							12	−0.726	0.092	13.3	−0.26	51.2
Pomona	11	−0.968	0.012	12.8	−0.34	37.2	12	−0.780	0.076	10.3	−0.24	42.9
Hunter	11	−0.824	0.065	10.1	−0.25	40.7	12	−0.814	0.066	12.8	−0.29	44.1
Fruita	11	−0.942	0.029	10.6	−0.30	34.8	12	−0.669	0.108	9.6	−0.20	48.0
Loma							12	−0.713	0.096	8.7	−0.21	45.7
Delta							12	−0.845	0.056	11.2	−0.24	46.7

CLASS III.—MORNING CONDITIONS=CLEAR; WIND 10 MIS./HR. OR HIGHER; MISCELLANEOUS PRESSURE CONDITIONS.

Grand Junction	24	−0.874	0.033	26.5	−0.56	47.1	12	−0.887	0.043	32.1	−0.68	47.2
Ground Exp. (G. J.)	24	−0.856	0.037	21.0	−0.51	40.9	12	−0.714	0.100	20.1	−0.38	52.9
Fruitvale							12	−0.652	0.117	20.7	−0.44	47.5
Palisade	24	−0.879	0.031	22.1	−0.50	43.7	12	−0.840	0.060	29.1	−0.70	41.9
Orchard Mesa							12	−0.762	0.085	25.1	−0.54	46.5
Pomona	24	−0.544	0.098	19.2	−0.52	37.2	12	−0.603	0.130	19.0	−0.47	40.4
Hunter	24	−0.704	0.070	17.4	−0.49	35.5	12	−0.784	0.079	22.6	−0.61	37.0
Fruita	24	−0.646	0.080	16.1	−0.48	33.7	12	−0.559	0.140	18.6	−0.47	39.6
Loma							12	−0.765	0.084	19.6	−0.55	35.6
Delta							12	−0.765	0.084	26.3	−0.80	32.9

CLASS IV.—MORNING CONDITIONS=PARTLY CLOUDY; WIND LESS THAN 10 MIS./HR.; MISCELLANEOUS PRESSURE CONDITIONS.

Grand Junction	14	−0.911	0.031	22.0	−0.36	61.0	17	−0.908	0.029	29.3	−0.49	59.8
Ground Exp. (G. J.)	14	−0.862	0.046	16.0	−0.32	50.3	17	−0.861	0.042	23.3	−0.42	55.5
Fruitvale							17	−0.752	0.071	22.5	−0.41	54.9
Palisade	14	−0.794	0.067	21.4	−0.38	55.9	17	−0.862	0.042	22.7	−0.39	58.2
Orchard Mesa							17	−0.839	0.048	23.3	−0.43	54.2
Pomona	14	−0.788	0.068	9.0	−0.26	34.4	17	−0.794	0.060	20.4	−0.41	49.8
Hunter	14	−0.827	0.057	13.5	−0.30	45.2	17	−0.900	0.031	22.2	−0.44	50.5
Fruita	14	−0.696	0.093	12.0	−0.25	47.5	17	−0.928	0.023	21.5	−0.43	50.0
Loma							17	−0.910	0.028	23.1	−0.48	48.0
Delta							17	−0.871	0.040	14.6	−0.47	31.1

CLASS V.—MORNING CONDITIONS=PARTLY CLOUDY; WIND 10 MIS./HR. OR HIGHER; MISCELLANEOUS PRESSURE CONDITIONS.

Grand Junction							17	−0.827	0.062	31.1	−0.50	62.2
Ground Exp. (G. J.)							17	−0.681	0.104	24.1	−0.36	66.9
Fruitvale							17	−0.722	0.093	24.0	−0.39	61.5
Palisade							17	−0.778	0.077	24.5	−0.47	52.1
Orchard Mesa							17	−0.746	0.086	25.8	−0.46	56.1
Pomona							17	−0.593	0.126	18.0	−0.31	58.1
Hunter							17	−0.631	0.117	19.5	−0.36	54.1
Fruita							17	−0.649	0.113	19.8	−0.36	55.0
Loma							17	−0.766	0.081	17.7	−0.35	50.6
Delta							17	−0.628	0.118	17.7	−0.37	47.8

NOTE.—The figures in the columns headed "$-a/b$" indicate, for the respective equations, the point where the graph intersects the X axis, i. e., at what relative humidity the temperature will probably be the same as the dewpoint.

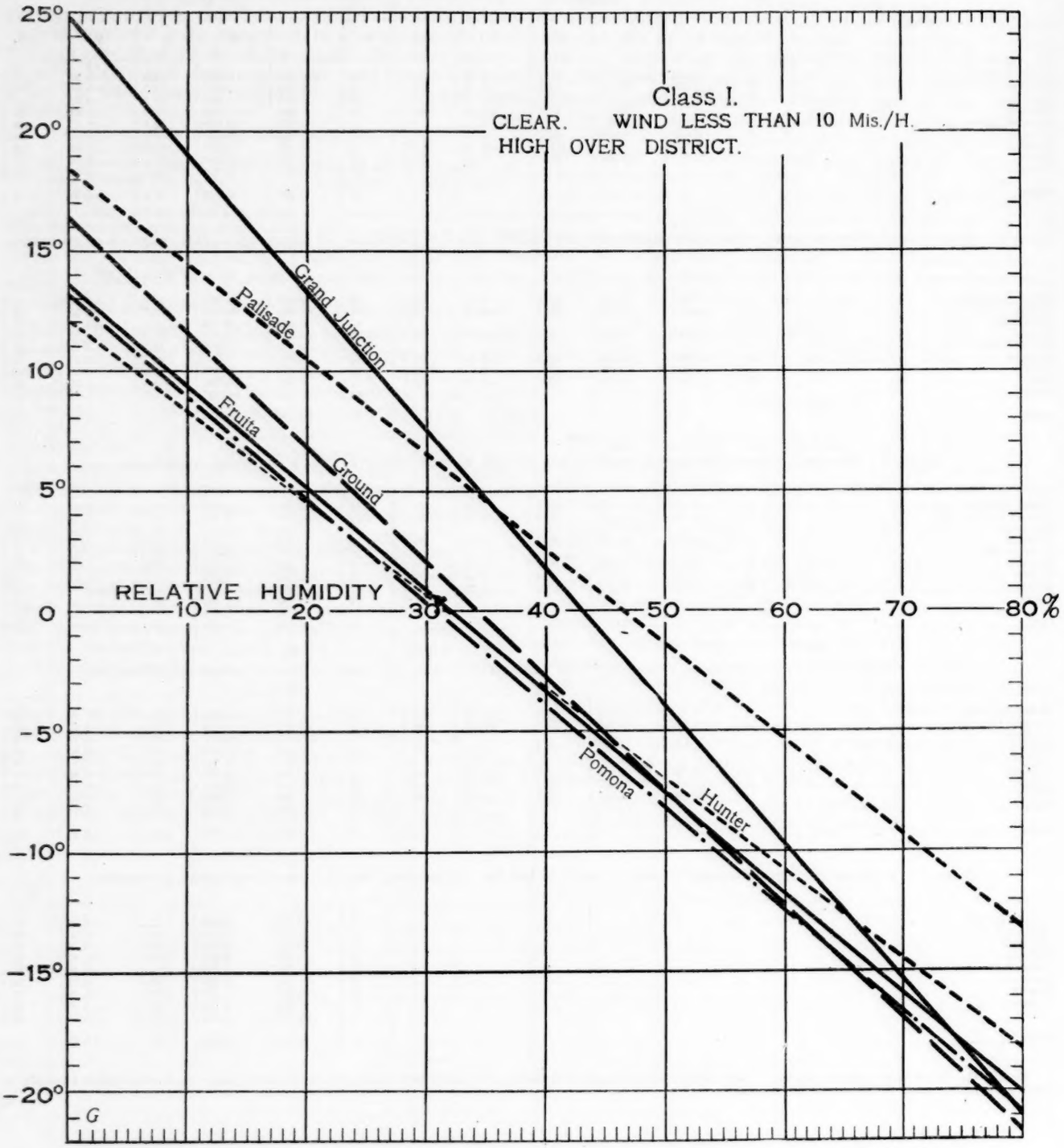

FIG. 1.—Graphs of equations for March for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

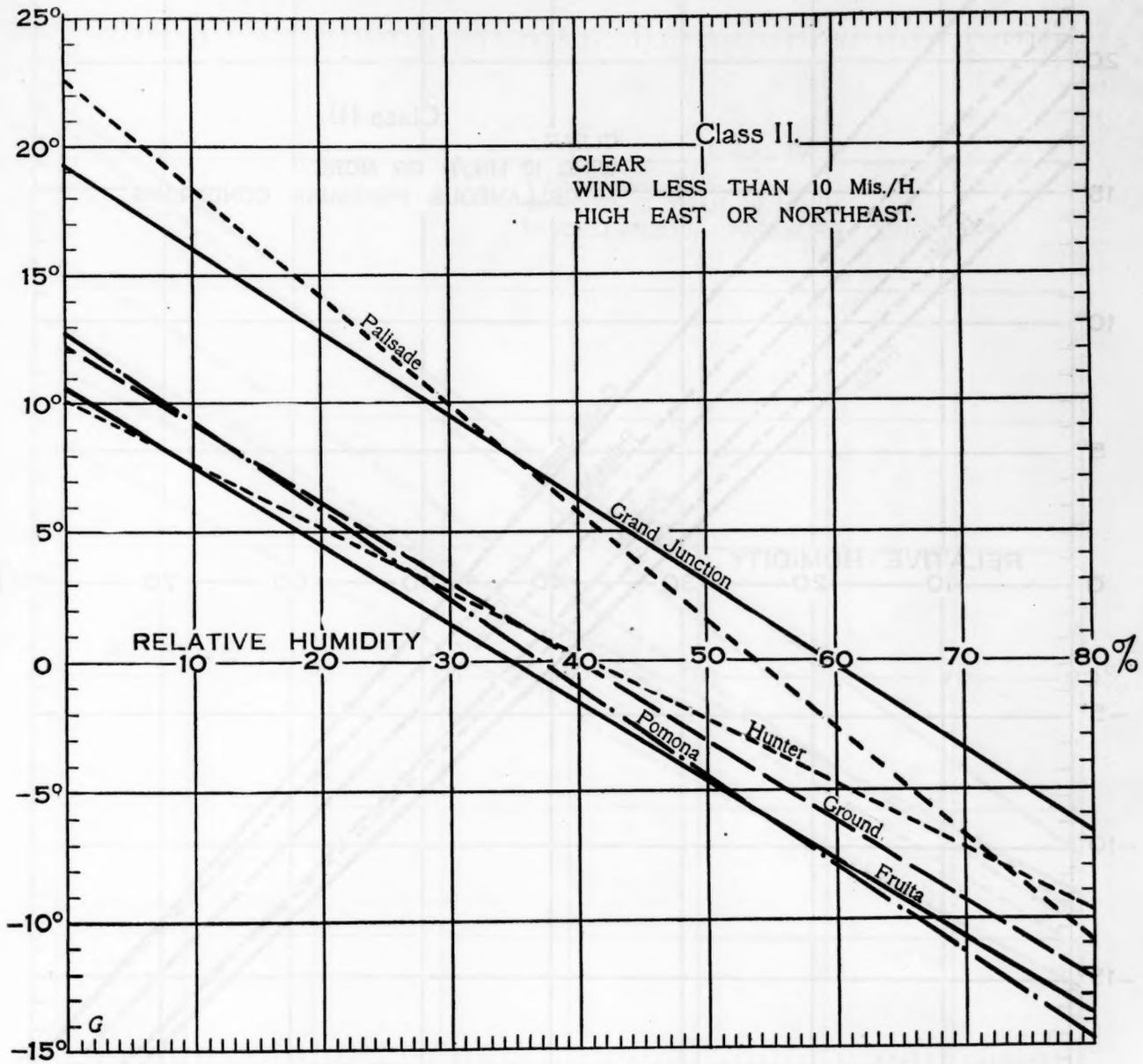

FIG. 2.—Graphs of equations for March for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

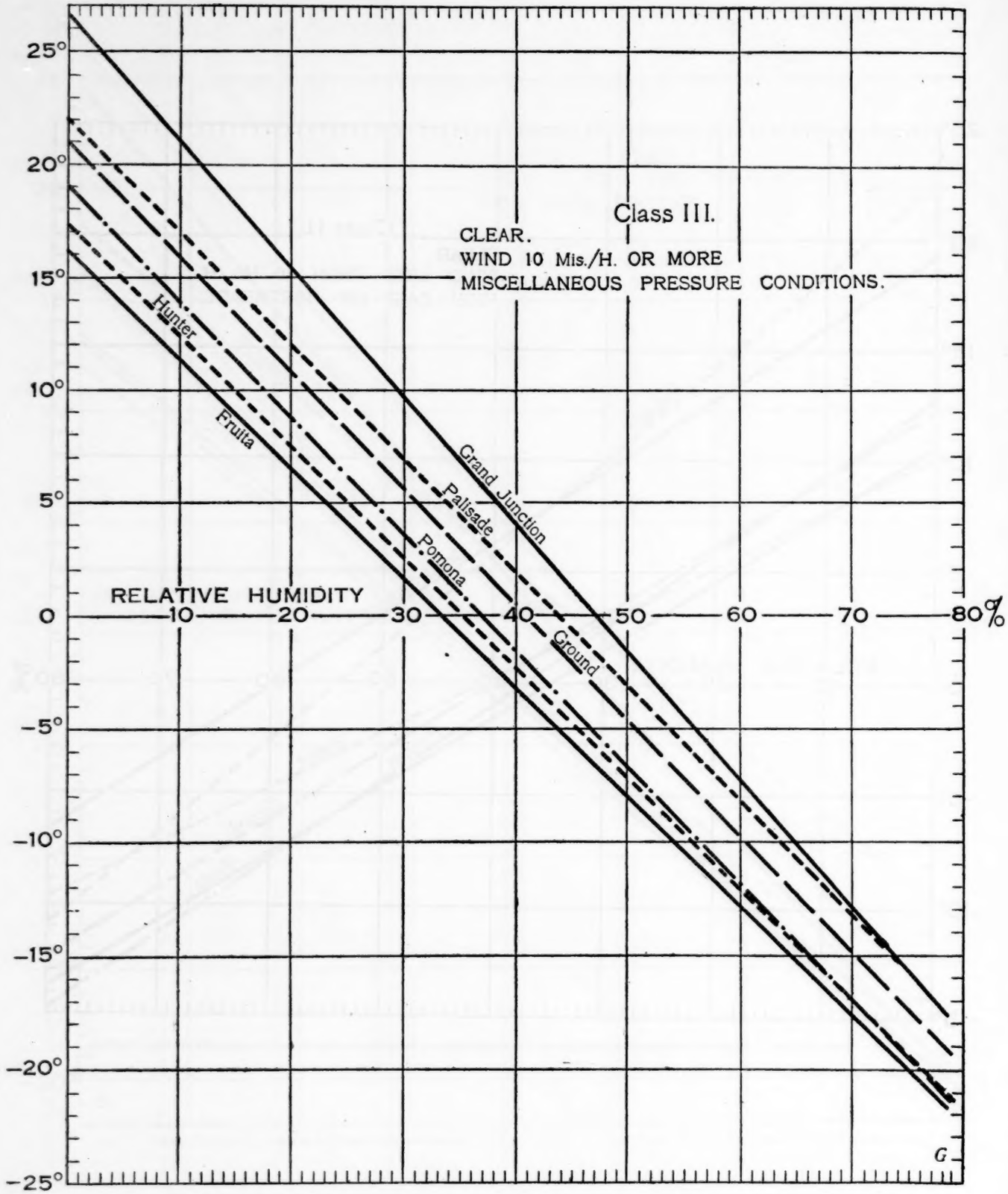

FIG. 3.—Graphs of equations for March for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

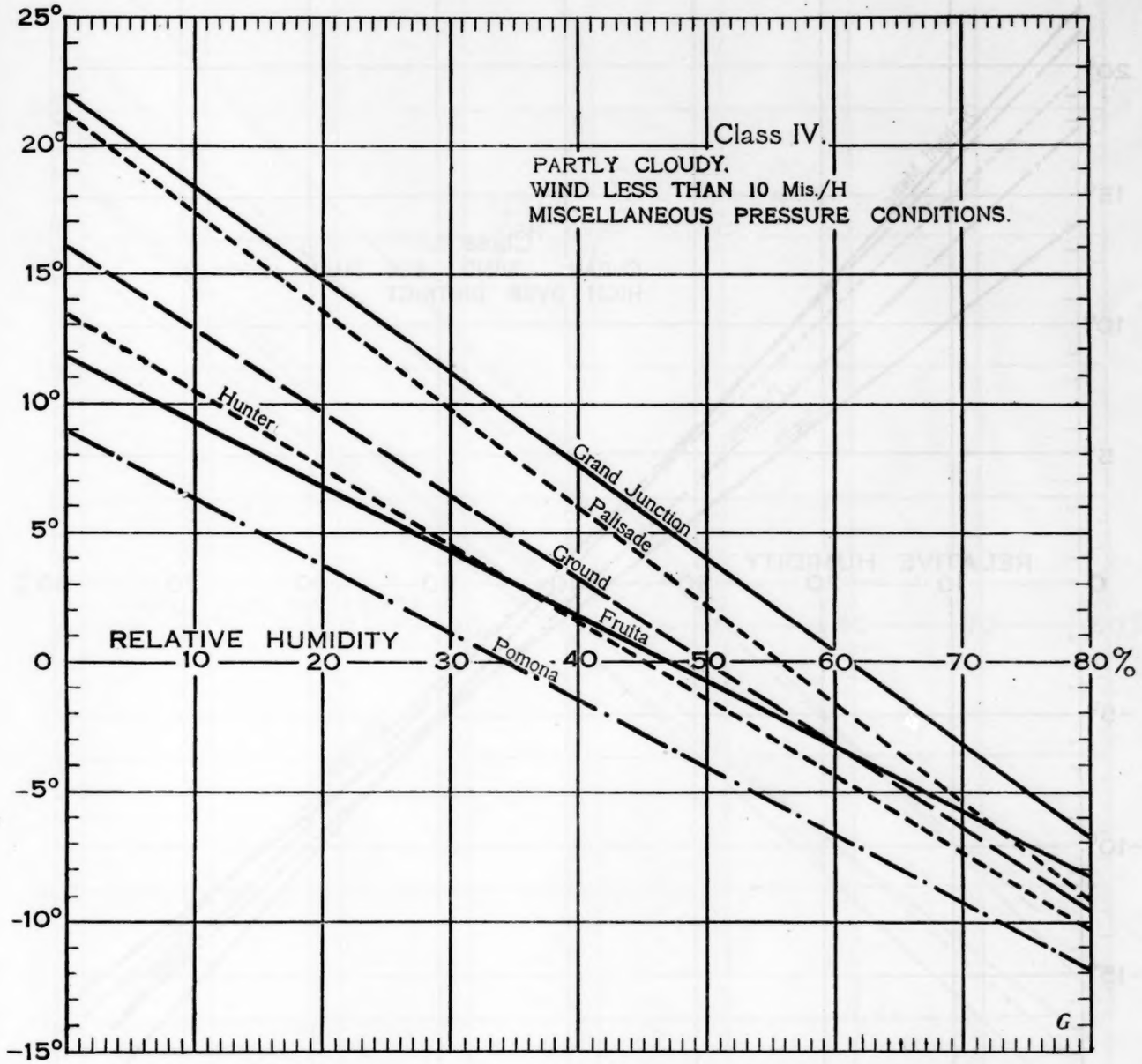

FIG. 4.—Graphs of equations for March for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

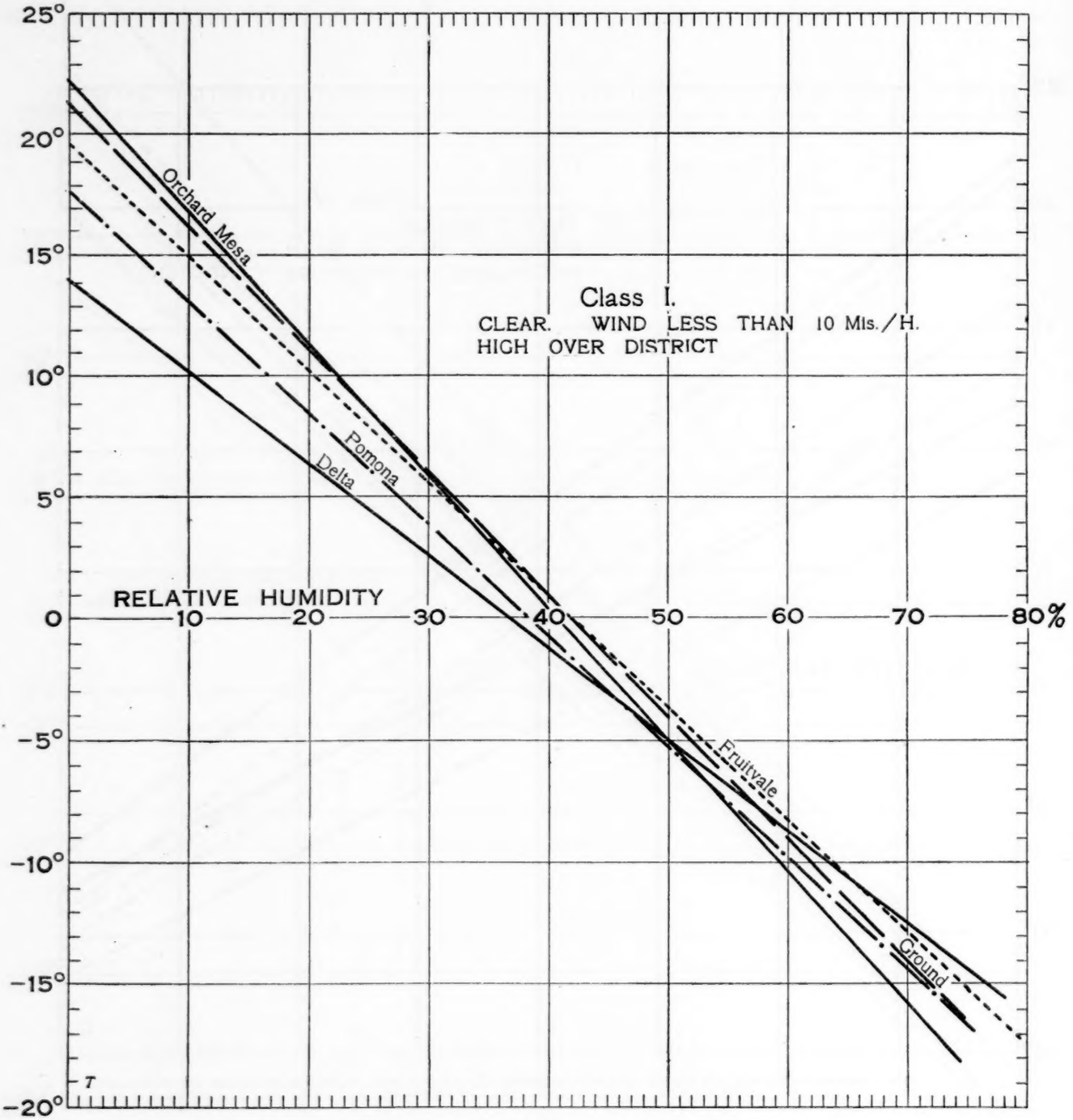

FIG. 5a.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

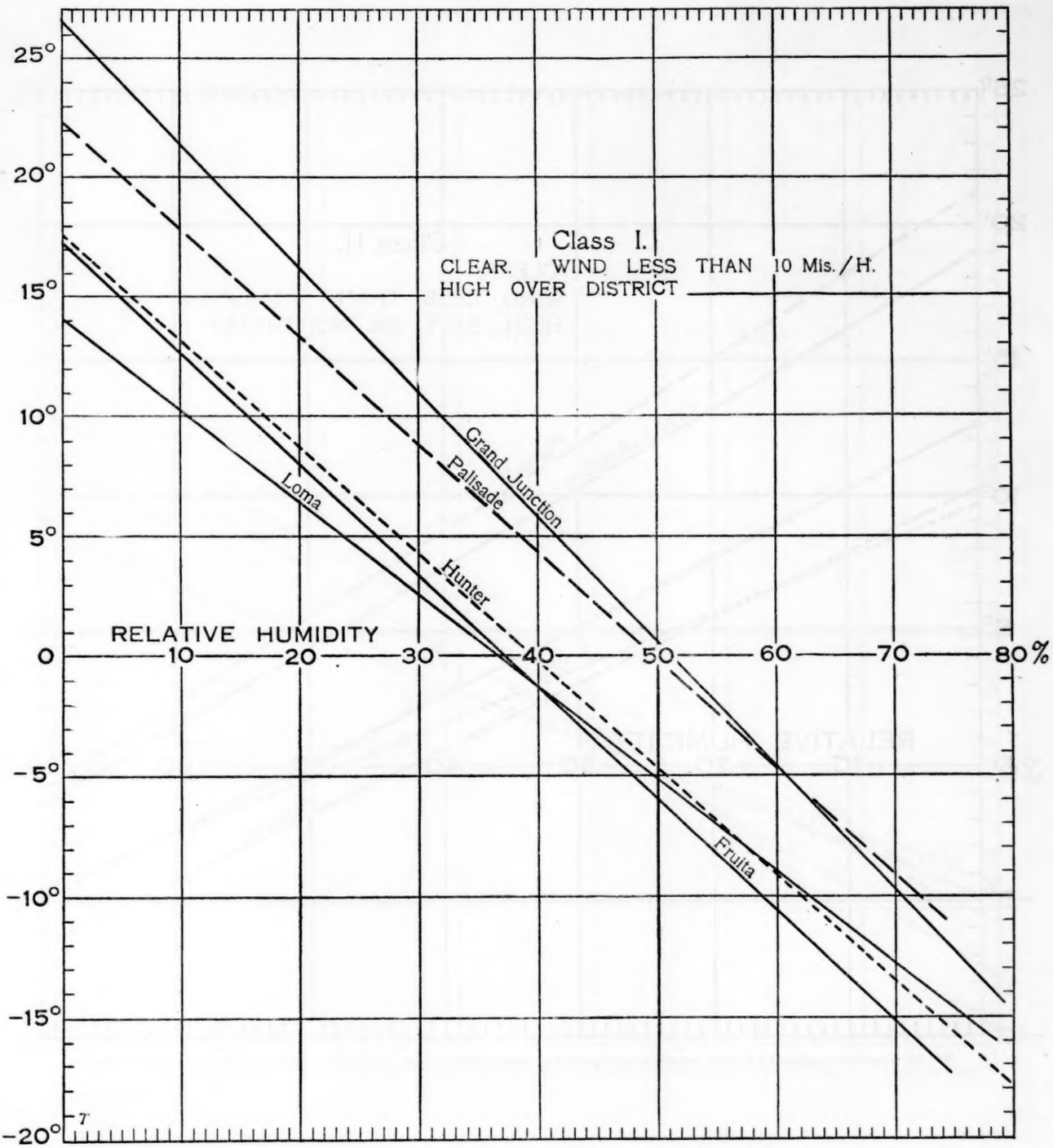

FIG. 5b.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

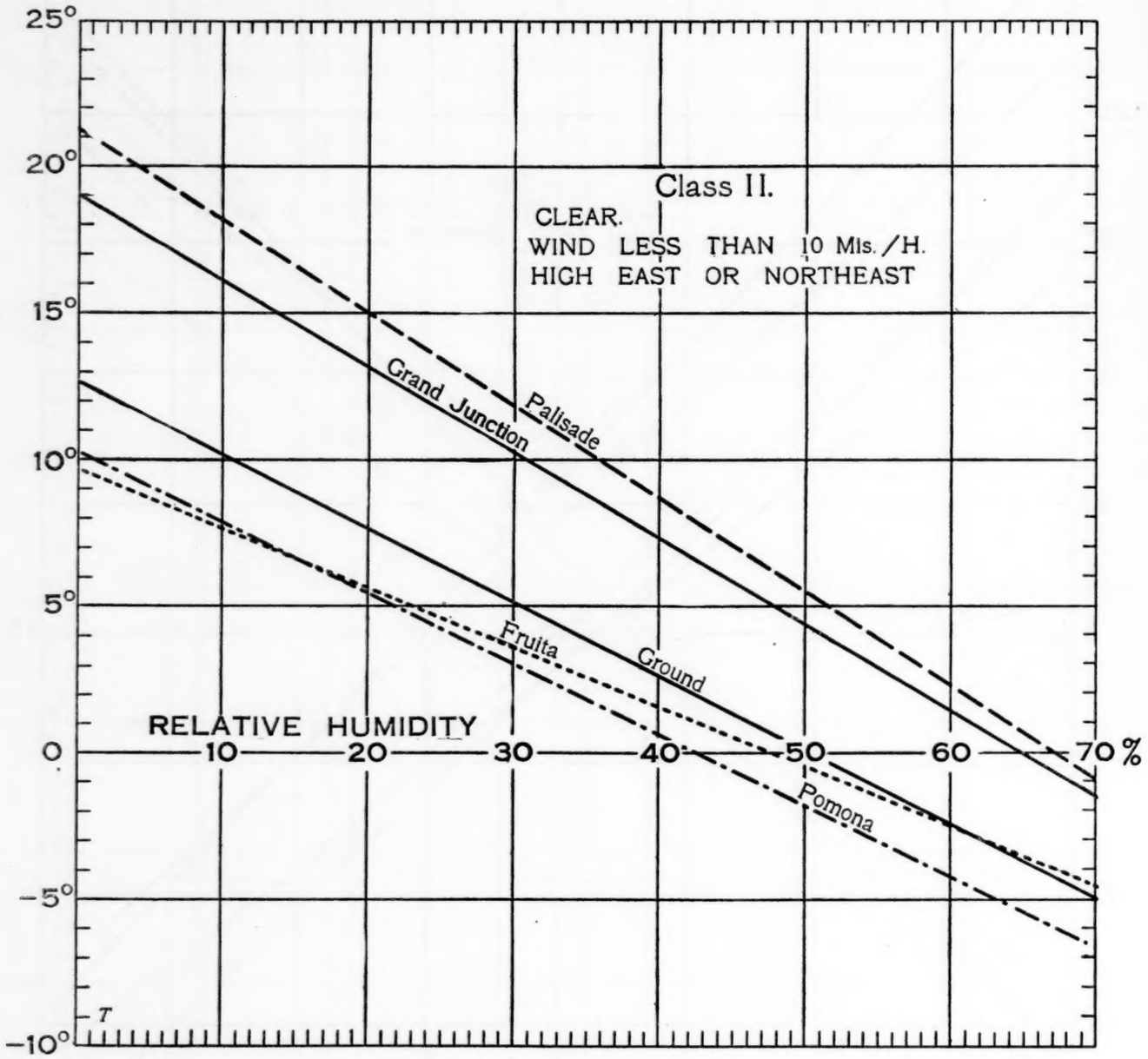

FIG. 6a.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

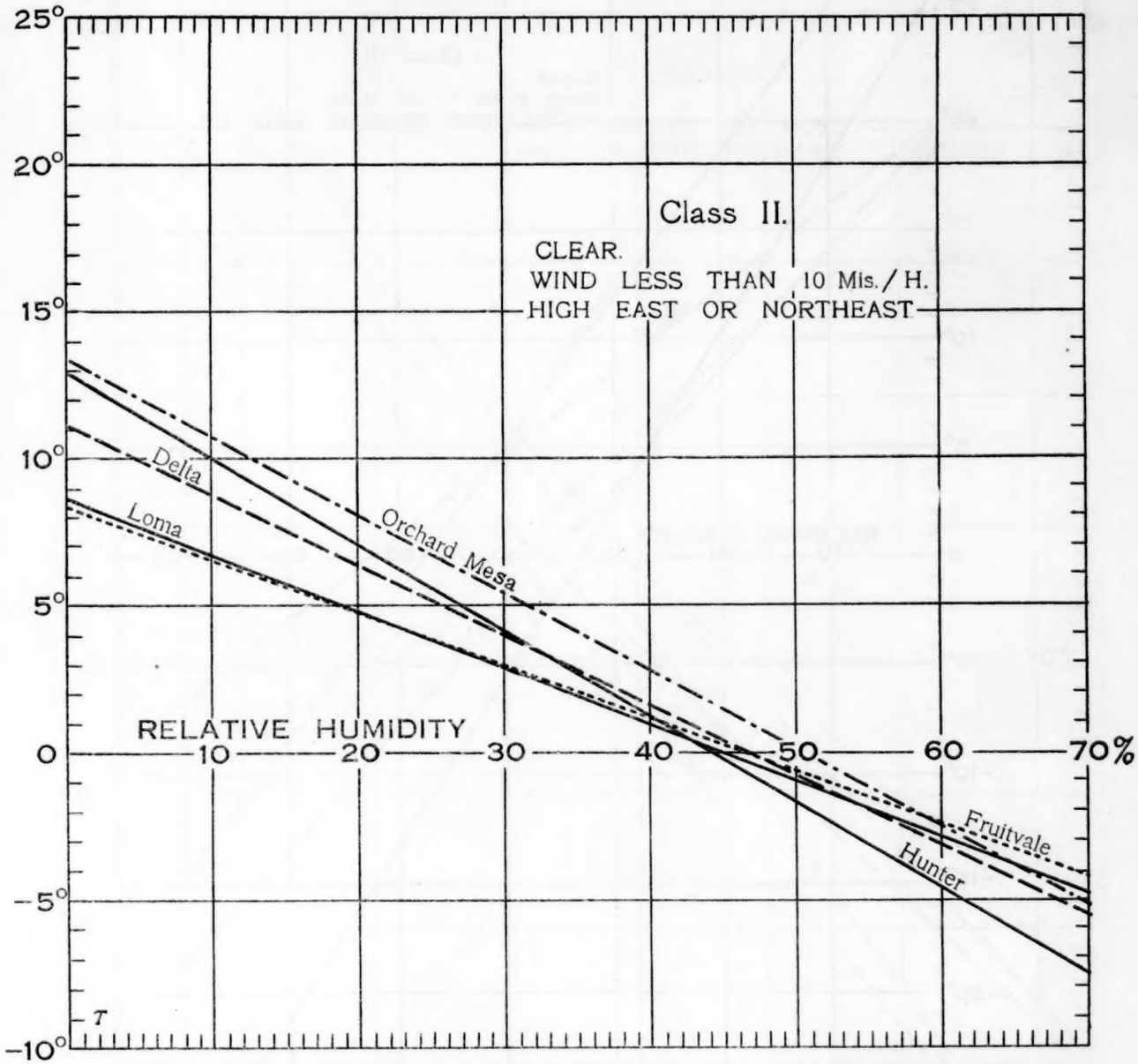

FIG. 6b.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

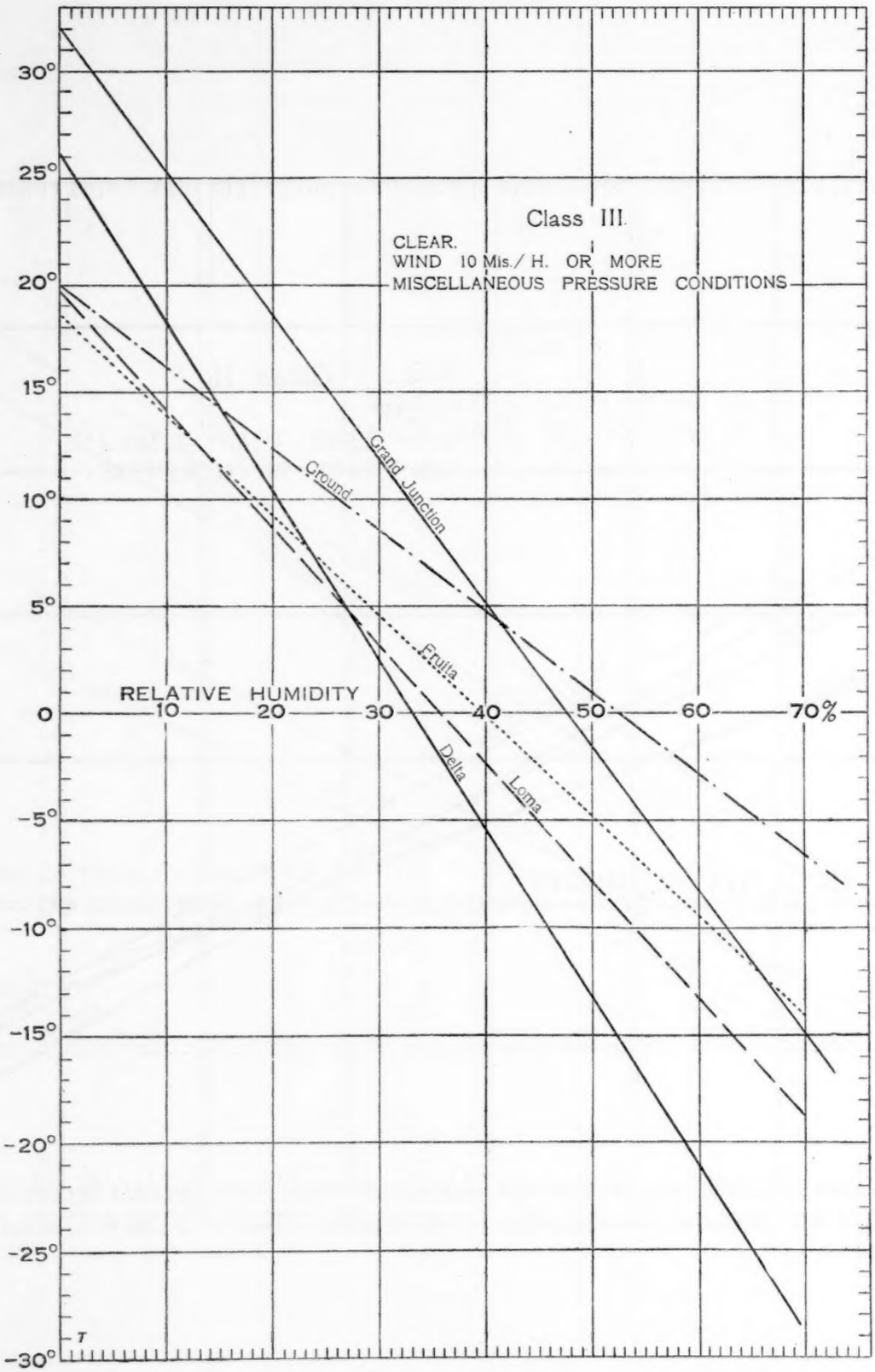

FIG. 7a.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

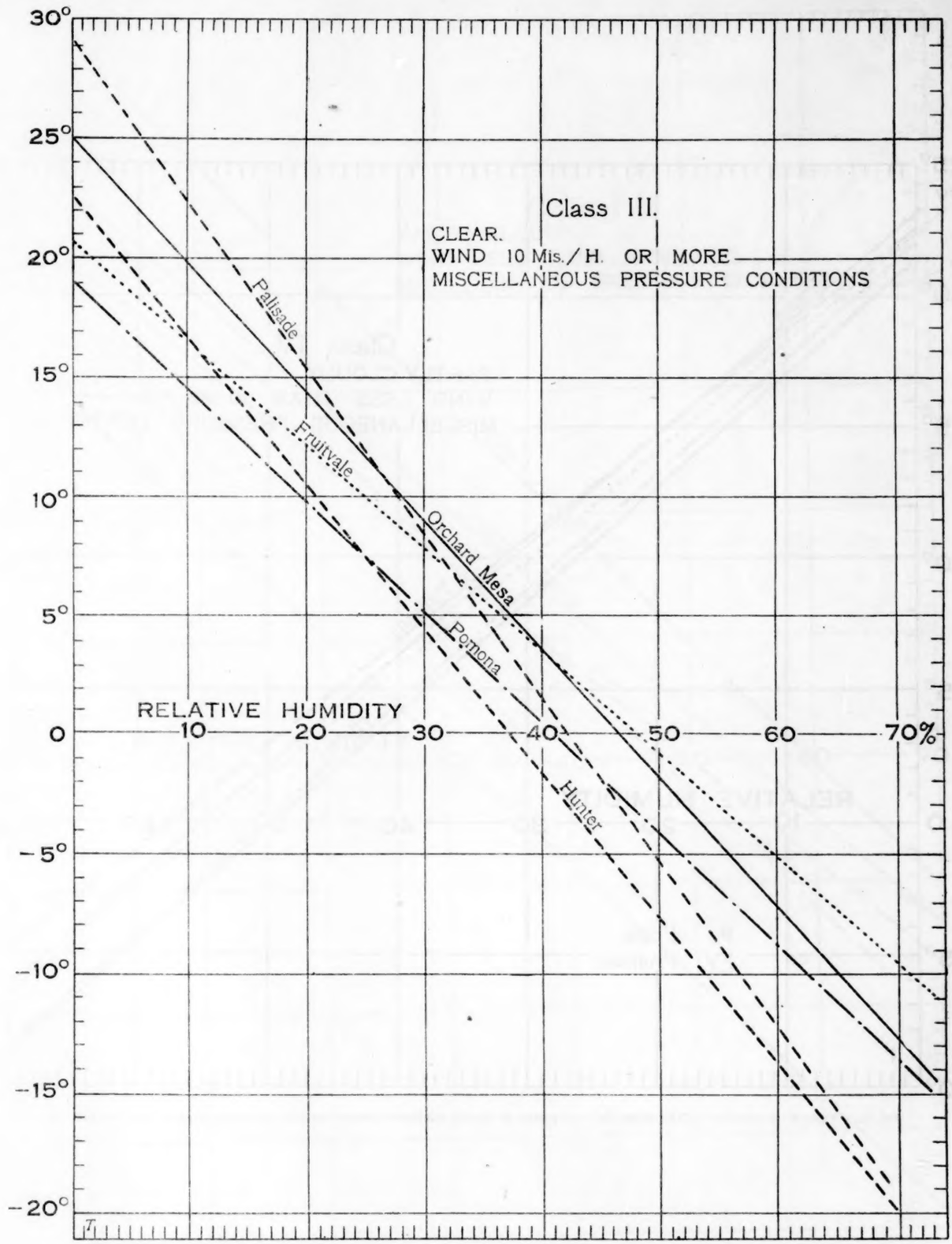

FIG. 7b.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

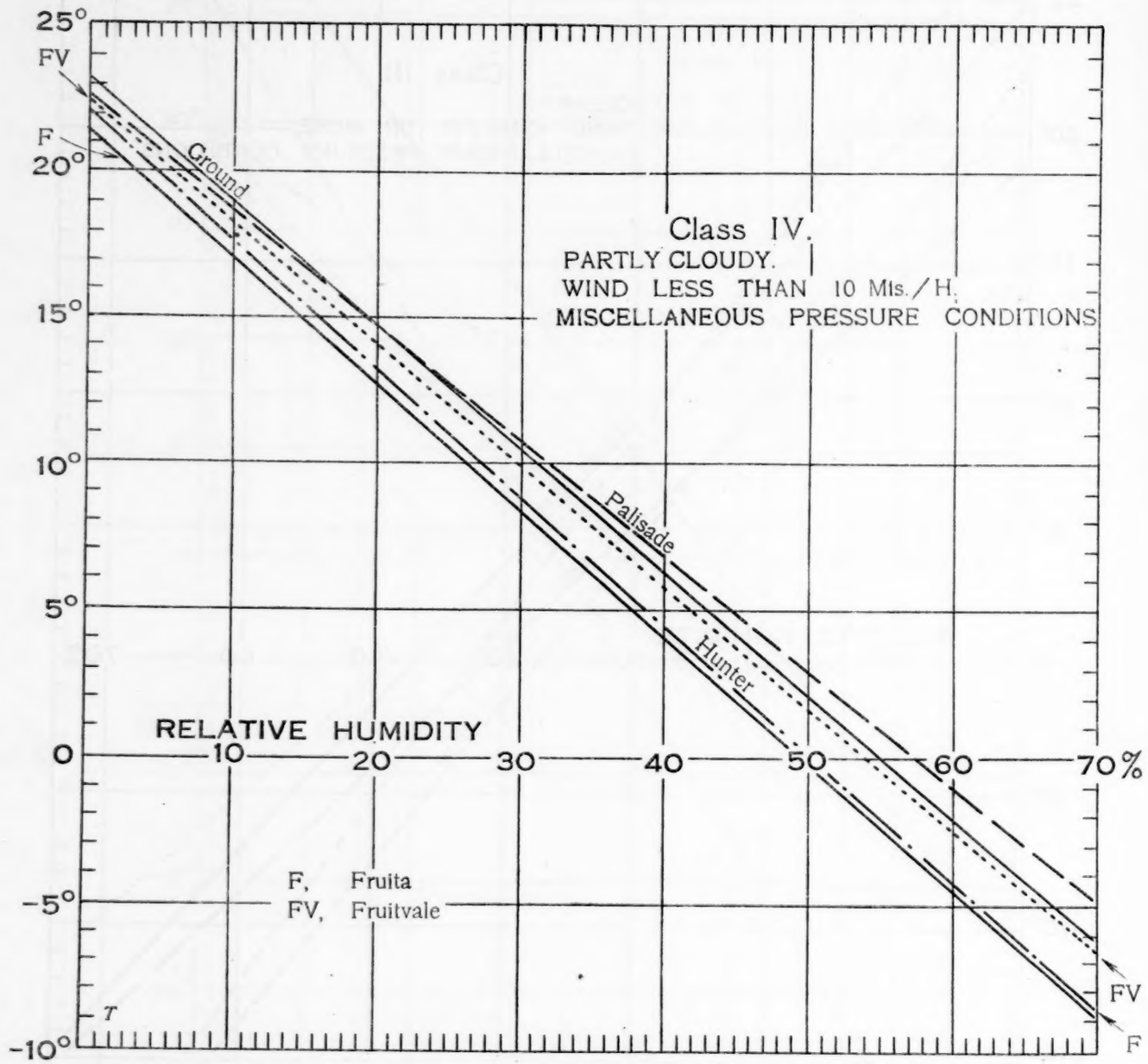

FIG. 8a.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

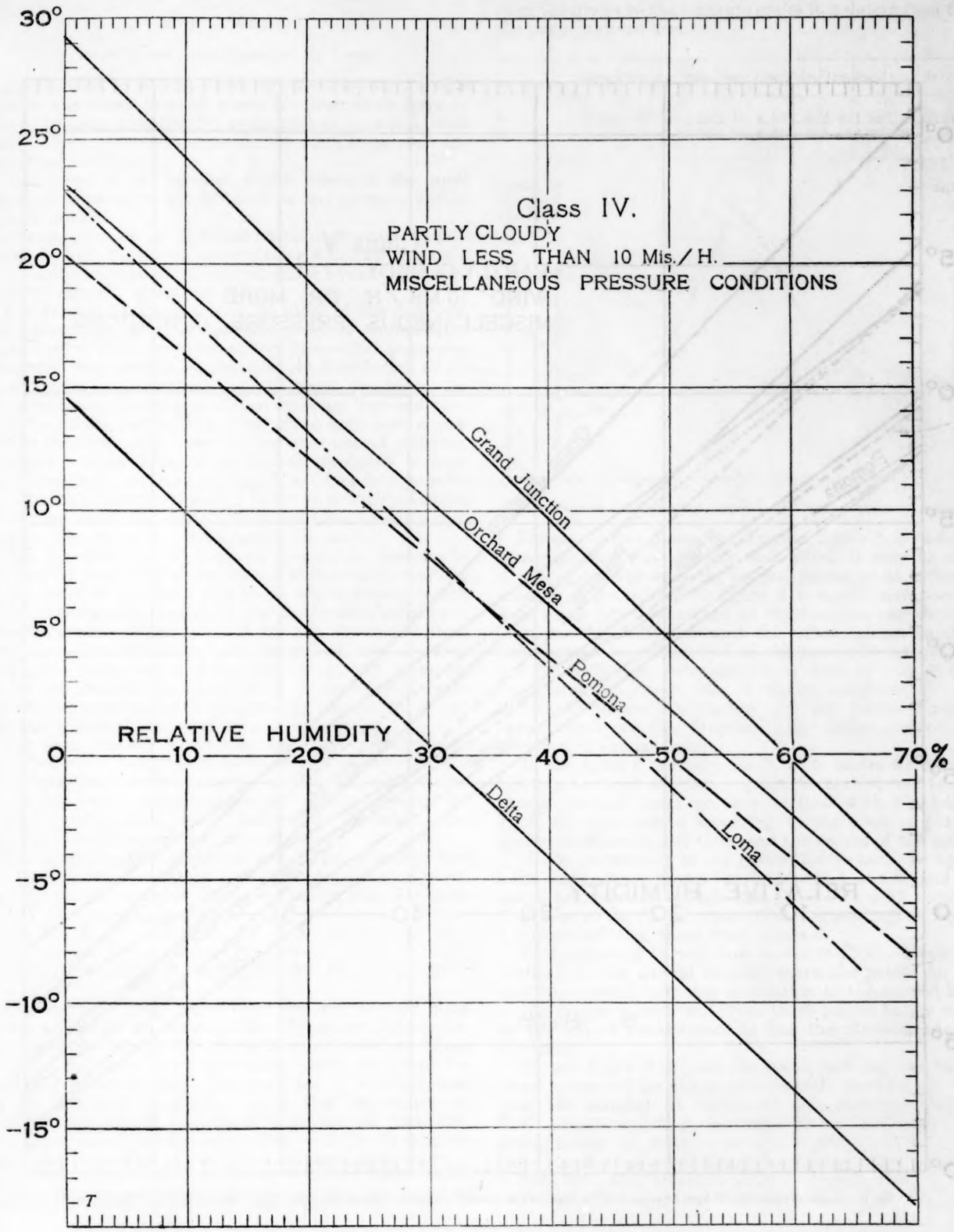

FIG. 8b.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

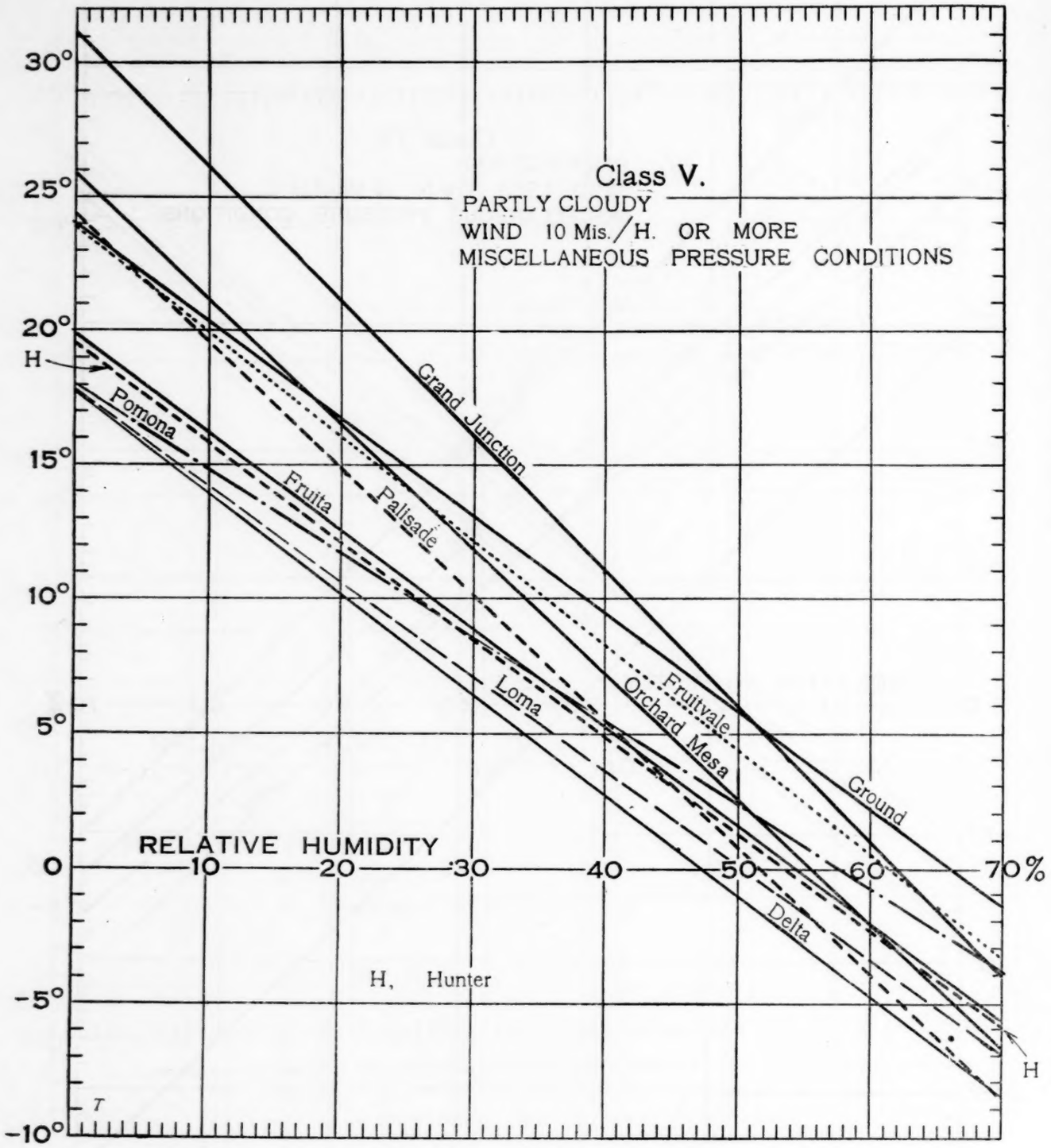

FIG. 9.—Graphs of equations for April for computing the departure of morning minimum temperatures from the evening dewpoint at Grand Junction.

RAINFALL AND RAININESS.[1]

By B. C. WALLIS.

[Dated: 18 Nassau Street, London, W., Apr. 7, 1918.]

An *isarithm* is a line drawn upon a map to indicate that all the places through which the line passes agree in regard to some quantitative evaluation of a geographical fact. The commonest examples of such lines are contours and isotherms.

An *isohyet* is an isarithm which refers to the total quantity of moisture precipitated as rain or snow within a given period.

An *equipluve* is an isarithm which deals with the proportion which the precipitation during a short period such as a month bears to the precipitation for a year. Isohyets indicate rainfall, *equipluves indicate raininess.*

For practical purposes, such as those of the engineer, the conservator of water supplies, isohyets are probably more useful than equipluves; for theoretical purposes, whenever the point of emphasis is *the distribution of the precipitation in time* rather than in space, equipluves for the several months are probably of more use than isohyets. To some minds, particularly those which have been accustomed through many years to the sole use of isohyets, equipluves make little or no appeal; probably because experience and continuous practice have made it possible to adjust the interpretation of isohyets in such a fashion as to read from the map showing isohyets the facts concerning the seasonal distribution of the rainfall.

The precipitation of a given locality is profoundly affected by minute local conditions, both those pertaining to the relief of the land and those which belong to the minor atmospheric conditions due to the accidental local circumstances. These local effects are eliminated from isohyets when the latter are smoothed and generalized in the construction of the map; they tend, however, to be nonexistent in equipluves. Consequently equipluves are more useful in the investigation, e. g., of the seasonal effects of elevation upon precipitation.

For these reasons, it may be advisable to indicate in brief fashion a mechanical device which shows the intimate relation between isohyets and equipluves. Given a monthly set of equipluves and also a map showing the annual precipitation, it is desired to determine the monthly precipitation in inches of rain.

For example, two places **A** and **B** are characterized by the following monthly numbers (pluviometric coefficients) on the equipluve maps, beginning with January:

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
47	54	84	102	155	205	170	120	98	72	58	35

The annual rainfall, read from the annual map is 24 inches at **A** and 37 inches at **B**. What are the respective monthly totals? A graph is constructed as figure 1. It is necessary to set up a scale beside the graph for each of the two places. The scale for **A** is determined by the fact that $\frac{1}{12}$ of 24 = 2, so that the inches are marked respectively on a level with the 50, 100, 150, etc., pluviometric coefficients. The scale for **B** depends upon the facts that $\frac{1}{12}$ of 37=3.08, and that, if P. C. 100=3.08 inches, then 1 inch=P. C. 32.5. Reading now from the graph to the separate scales it is determined that the precipitations are:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
A	0.94	1.08	1.68	2.04	3.10	4.10	3.40	2.40	1.96	1.44	1.16	0.70
B	1.45	1.66	2.58	3.14	4.77	6.31	5.23	3.69	3.02	2.22	1.78	1.08

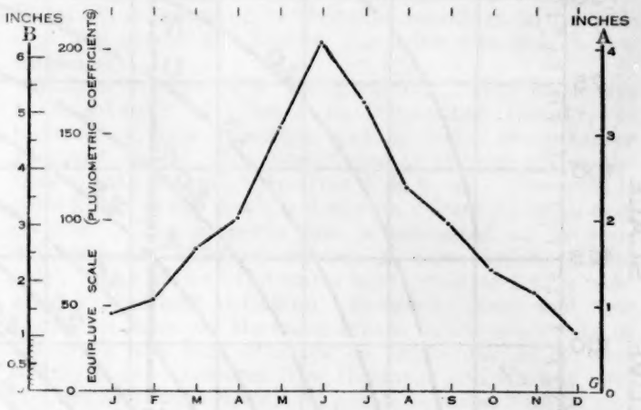

FIG. 1.—Diagram showing relation between isohyets and equipluves for **A** and **B**.

For one or two places the diagram, figure 1, is useful in consequence of the rapidity with which it may be constructed; but for work on several places or at different dates a diagram such as figure 2 is much more useful. Two scales are determined at right angles, one showing pluviometric coeffcients and the other annual rainfall. Calculations are made to find, for example, the pluviometric coefficients equivalent to 1 inch of rain out of the annual totals—5, 10, 15 inches, respectively; the calculated values are plotted and the 1-inch curve is then drawn on the diagram. The other curves are obtained in similar fashion.

To use figure 2 to read from P. C. to inches (or cm.).—Draw a vertical on the diagram to correspond to the annual rainfall, mark on this vertical with the letters *J*, *F*, etc., the values according to the scale of pluviometric coefficients, and then read the values of the points *J*, *F*, etc., in relation to the curves for inches. In figure 2 the verticals are drawn for the places **A** and **B**, and the points are marked in each case for 6 of the 12 months. A glance at the figure shows that the readings of figure 2 correspond with those from figure 1.

To use figure 2 to read from inches to P. C.—Draw the vertical for the annual rainfall, mark the points for the monthly rainfall in inches in relation to the curved lines of the diagram, and read from these points to the scale on the left of the diagram to find the pluviometric coefficients.

To use figure 2 to find the rainy and dry seasons.—Draw a vertical for the annual rainfall, read on the vertical the number of inches of rain corresponding to P. C. 100, 50, and 200. Examine the values for monthly precipitation in relation to the limits thus obtained: Over 100 P. C. is wetter than the average, over 200 P. C. is very wet, and below 50 P. C. is very dry.

[1] Papers dealing with the pluviometric coefficients of the United States will be found in the MONTHLY WEATHER REVIEWS for 1915, January, April.—EDITOR.

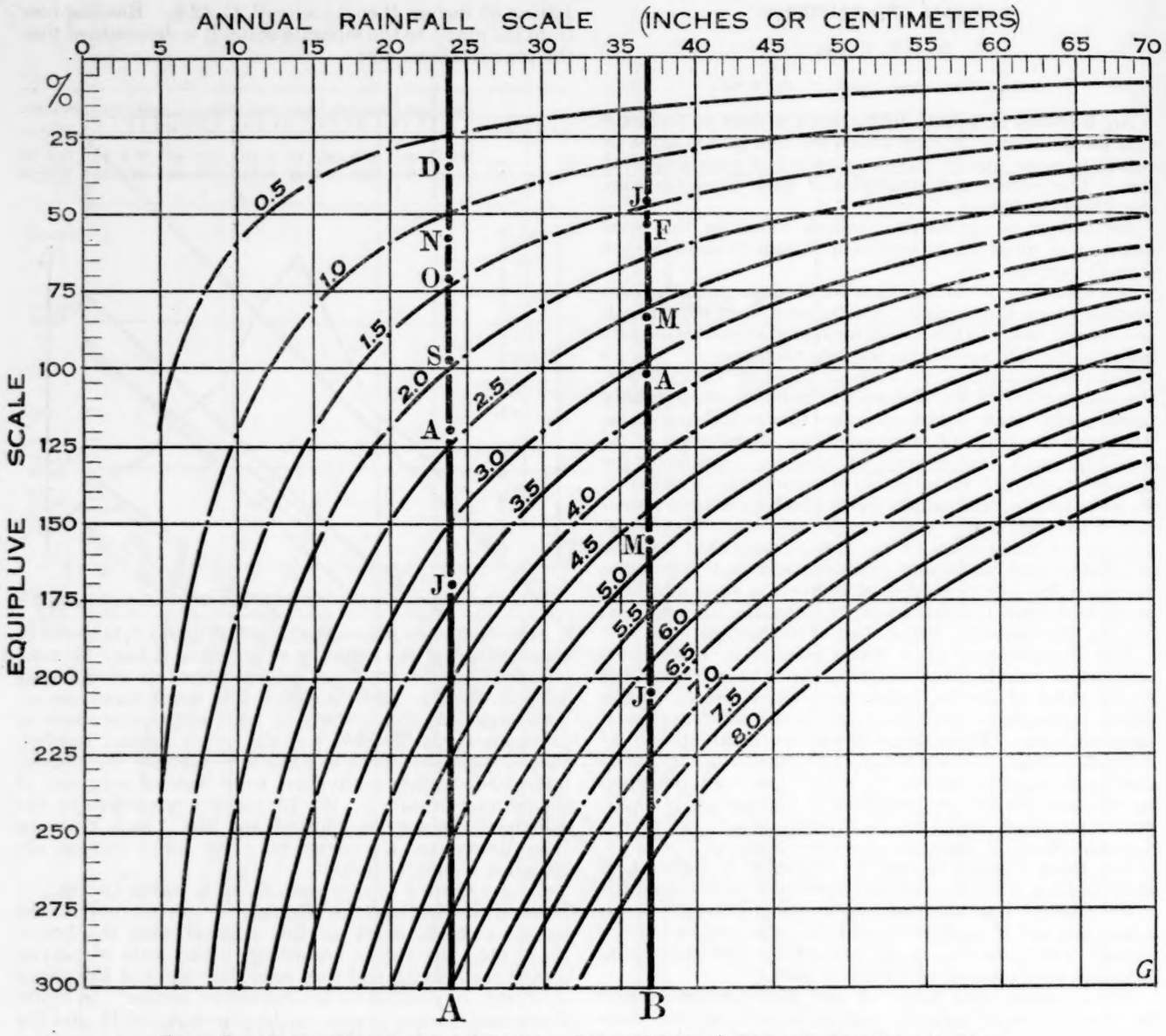

FIG. 2.—Curves for general interconversion of pluviometric coefficients and depths of rainfall, and rapid estimation of raininess.

TORNADO OF MAY 9, 1918, PEARL ROCK TO CALMAR, IOWA.

By HAL P. HARDIN, Observer.

[Dated: Weather Bureau, Charles City, Iowa, May 25, 1918.]

(75th meridian meantime used herein.)

A tornado passed east of this county, Floyd, during the afternoon of May 9, 1918. The storm had some features which have made it difficult to determine whether there was more than one tornado, or only one storm that zigzagged over a strip 2 miles wide and 54 miles long. A straight line through the middle of the zone showing wreckage runs due SW.–NE. and encounters as many buildings and groves untouched as it does objects destroyed, while the character of the wreckage at points a mile or less from such a median line leaves no doubt that a tornado had visited them.

The writer visited Pearl Rock during the afternoon of the following day, i. e., May 10. There the width of the storm's path of destruction was about 200 yards, and could be defined as such for a distance of 2 miles from southwest to northeast. There was no indication of a whirling wind outside that belt, nor for some distance at either end of it. A number of persons who went through the storm at Pearl Rock and other points have told me that they saw the funnel-shaped cloud, heard a roaring noise as that of a rapidly moving railway train, and witnessed an inward-and-upward movement of objects toward it.

Pleasant Valley.—A man who observed the first known formation of the funnel cloud at Lower Pleasant Valley, the point where the storm apparently originated, described to me what he saw, as follows: The weather had been warm, with thundershowers during much of the day. Shortly before 4 p. m. two thunderstorm clouds

moved rapidly from the west and the east toward each other; there was vivid lightning with loud thunder, and the heat became oppressive. There had been strong winds during the day, but with the gathering of these clouds the wind ceased until there was no surface air movement. Overhead the clouds seemed to be boiling; in each bank light and dark clouds seemed to be trying to climb over one another. The two banks met over a point about 1 mile northeast of where the observer stood. There was less lightning and thunder than before; the western cloud bank absorbed that bank which had come from the east, all light shades disappeared, and the whole mass turned blue-black in color. There was a roaring noise, and from the point where he judged the lower edges of the clouds had met a downward bulge appeared and quickly developed into the funnel. A twisting, gyral motion was seen in the funnel, and he thought that he had noticed a revolving movement in the whole bulging portion of the cloud, but was not sure of it as he had not thought to look for it at the time. As the cloud started northeastward heavy rain and light hail fell where the observer stood, followed by light rain, high wind and cooler. This man was on an elevated piece of land, and says he could plainly see the funnel for 4 miles, and that it moved straight northeastward toward Pearl Rock. All the damage in that 4-mile stretch is within a belt half a mile wide. There then follows a long reach without a visible trace of the storm; but there, as elsewhere in the storm's track, the greater part of the country is in pasture land and fields on which there are now no crops. There are no trees except along the banks of streams and around farm buildings.

Pearl Rock.—Pearl Rock is a cluster of 8 or 10 farm houses at the crossroads forming the boundary lines between four counties—Butler, Floyd, Chickasaw, and Bremer; it is some 8 miles from the neighborhood known as Lower Pleasant Valley and lies northeast of the latter. The storm struck there (Pearl Rock) at 4:20 p. m., killing one woman and causing a property loss in and near the village estimated at $50,000.

Nashua.—After leaving Pearl Rock there is a reach where the path of the storm is lost before it struck (4:30 p. m.) the eastern side of the town of Nashua, Chickasaw County, 3 miles northeast of Pearl Rock. I was given practically the same description of the formation of a tornado cloud before the Nashua damage began, as that given by the man at Lower Pleasant Valley. The people who witnessed the gathering of the clouds did not then know that a tornado had visited Pearl Rock and thought that one was originating over them. They had the same weather and subsequent changes as at Lower Pleasant Valley: Saw two thunder clouds meet; heard the same roaring and saw the funnel descend. Along the river bank, and at the apparent end of the storm track from Pearl Rock toward Nashua there is a heavy timber growth. The upper limbs of the trees are stripped of branches, foliage, and so much of their bark that their nakedness is noticeable as far away as the trees can be seen. None of the trees are uprooted or show damage near the ground. If the storm at Nashua was the same one that formed at Lower Pleasant Valley and later struck Pearl Rock, the funnel was receding into the cloud when it passed over those trees, and had lost its identity when the cloud approached Nashua.

In eastern Nashua and near by, one man was killed and about $100,000 worth of property, mainly farm buildings and stock, was destroyed. The time is generally placed at 4:30 p. m.

New Hampton.—From Nashua the storm's track lies northeastward to New Hampton, in Chickasaw County and 18 miles from Nashua. The time it struck New Hampton is placed at 5 p. m. Between the two towns the destruction of property was great in localities, with no trace of the storm at other points within the reputed 2-mile width of its path. One woman was killed 6 miles southwest of New Hampton, one man on a farm a mile north of where the woman was killed, and a boy 1 mile south of the town. The property loss in and near New Hampton is estimated at $160,000, mostly in farm buildings and stock; the loss in the town was only a few thousand.

Calmar.—From New Hampton the storm track lies northeastward to Calmar, in Winneshiek County, 25 miles from New Hampton and 54 miles from Lower Pleasant Valley. The postmaster at Calmar places the time of the storm's arrival at 5:30 p. m. Two people were killed in the town and one on a farm 1½ miles east of town. The property loss is estimated at between $200,000 and $250,000, mainly in farm buildings and stock. The path of the storm is reported as 1 mile wide and 15 miles long at Calmar. Between Calmar and New Hampton there are the same breaks in the continuity of the track and lack of evidence to sustain its reputed width, as exist between New Hampton and Nashua, and Nashua and Pearl Rock. At points between Nashua and Calmar there are communities within short distances from the reputed storm track where only black, threatening clouds were seen.

General character of weather along path.

Over the entire length of the track wherever there is trace of the storm in fallen trees, poles, and wrecked buildings the fall of objects was toward the north on the southeast side of the track and toward the south on the northwest side, except that some groves and buildings appear to have been uprooted or torn to pieces and then dropped in a confused heap. Probably the latter distributions occurred in the center of the vortex; owing to the predominance of open fields, one can not locate the exact center of the track.

All along the line reports agree that fresh winds and thundershowers occurred previous to the storm; that its approach was heralded by sharp lightning, loud thunder, tumbling light and dark clouds which changed to blue-black with pendent funnel; that a roaring noise was heard; that still air and excessive heat immediately preceded the blow which whirled around the funnel; that rain and hail accompanied the blow and light rain and falling temperature followed it. No damaging hail is reported.

If the same storm was concerned throughout, it progressed northeastward 54 miles in 1 hour and 30 minutes, a little better than ordinary automobile time. Its actual path was between 200 and 400 yards in width, but it seems to have ranged over a course 2 miles wide, in much the same way as a sailing vessel tacks over a wide course when beating to windward.

Injuries to population along route.

There were 8 lives lost, about 20 people injured, and about $500,000 worth of property destroyed. All but two of the people killed were on farms, and all but a small portion of the property loss was in farm buildings and stock.

The dead lost their lives in the following ways:

Mrs. A. C. Carpenter, Pearl Rock: Struck by flying board while in the yard, unreasoningly refusing to enter the cellar under the house as her companion wished her to. Results proved that she would have been safe in the cellar.

Mr. Roy Husband, near Nashua: Struck on head by falling cement block while in the cellar under building which was wrecked. The cellar was filled with wreckage; there were five others in it and all were more or less injured, but none have since died.

Mrs. Alice Dowd, 6 miles southwest of New Hampton: Manner of death unknown. Eighty-four years old and alone in building. Body found within foundation of barn, which had been blown away, badly broken and bruised. That she was killed while within the home near by was established through a piece of the frame of her dead son's picture which she still retained in hand. The picture had hung in the living room, and when she felt the house going she probably tried to save it.

Mr. Albert Smith, 5 miles southwest of New Hampton: Struck on the head by a block from the chimney when the house was demolished. Wife and child with him escaped with bruises.

Theo. Krueger, jr., 1 mile south of New Hampton: Killed by falling barn in which he had just placed horses. He and his father were bringing school children home in a wagon. When they saw the storm approaching they drove into a farmyard and sent the children into the cellar under the house. They then drove the team into the barn. The father remained outside; when the storm struck him he clung to an apple tree and escaped with bruises.

Mr. and Mrs. Peter Anderson, Calmar: Killed when their house fell to pieces and the wreckage of other buildings was piled on its ruins.

That more lives were not lost is partly because the storm did not cross the crowded parts of the few towns that it touched; and partly because its slow forward movement gave people time to seek cellars and other relatively safe places after they saw it approaching. Some such reported instances in illustration, follow:

Miss Vera Deisler, teacher at the Pearl Rock school, formed her pupils in a chain of clasped hands and led them to a hedge to which they all clung with the strength of desperation until the storm passed. The school building was scattered far and wide.

At one schoolhouse, totally wrecked, it is claimed that the change in time, daylight saving, probably saved many little children from death or injury. School had been dismissed for the day long enough for the children to have reached their homes. Under normal time they would have been in the building.

At another schoolhouse they were having a picnic in celebration of the end of the term. It was filled with women and children. When the storm was seen approaching they fled to a near-by farmhouse cellar. The house over the cellar was completely blown away, but not one of the thirty occupants of the cellar was injured.

East of Nashua there is a group of Piersons, father and sons, on adjoining farms. All took to cellars, and while some of the houses went away no one was hurt. Mr. E. D. Pierson, his wife and five children went into the cellar. Before they realized that their house had been hit they were looking up into the very heart of the tornado, which was trying to lift them out of their refuge. By clinging to each other and to the wall of the cellar they managed to stay on the floor till the storm passed.

Some children alone at their home remained in the yard until they saw a neighboring place going, then took to their cellar. The house and outbuildings were wrecked, but when the parents returned they found the children safe.

But a cellar under a building is not always a safe refuge. In the above accounts, it is related that one man was killed and others injured by falling débris while in such a cellar. Some of the reported in stances where the cellar was unsafe were:

Mr. Cecil Gray, near New Hampton, would not risk the cellar because it was shallow. He, his wife, and child clung to some lilac bushes and escaped. The house tumbled into the cellar and the wreckage caught fire.

Mrs. McGrath, near Nashua, led her children into a plowed field where all lay in furrows with safety. Had they gone into their cellar they would probably have been killed, as the house collapsed and fell into the cellar.

Mr. Strawson, near Nashua, had a new modernly constructed home, one of the best farm buildings in this section of rich farms. Before going into the basement he took the precaution to throw water on the furnace fire to guard against that possible danger, thinking the basement otherwise safe. When the storm began tearing the house to pieces he and his family huddled together in the northwest corner. Suddenly a section of the roof dropped over them, one edge resting on the foundation wall, and at the same time the rest of the basement was filled with wreckage and their section of roof was piled high with it. But for the lucky falling of that piece of roof they would all have been killed.

Evidently the safe cellar is one located far enough away from buildings to be reasonably safe from falling wreckage and having a sod roof.

Some reported tornado freaks:

Mr. Smith, fishing from a boat on the Cedar River near Nashua, was thrown from the boat. He clung to same bushes and was whipped about by the wind until his arms were nearly torn from his shoulders, but saved his life. The boat was broken up.

A family caught in a plowed field lay the storm out in furrows. There was a dog with them. As the cloud approached, the dog was seen to be desperately trying to dig himself into the ground. When the cloud was over them the suction was so great that the people had all they could do to stay in the furrows and did not see what happened to the dog. After the storm he was gone. The next day he limped into the farmyard, footsore and exhausted; much of his hair was gone and the remnant twisted or on end. Those people think that the dog was sucked up into the cloud and dropped a long way from home.

That this explanation of the dog's appearance and long absence is not improbable is evidenced by the mud deposited on buildings and other objects struck by the storm. This mud had been picked up from wet plowed land and carried along, possibly many miles. Also, along the path of the storm dead chickens were found, their bodies crushed flat and entrails protruding. It is claimed that a strong man could not throw a full-grown hen against the ground hard enough to produce that result. Apparently the storm picked them up and then threw them down with great force.

A large silo at Pearl Rock had its staves pushed in, but not broken. The roof was merely pushed partly off. The silo had a small quantity of ensilage in it. The staves were raised off the bottom boards some 10 to 18 inches. There are the usual number of rod-iron hoops on the silo. None of these broke.

The Cedar Valley Electric Co. has a power circuit of large copper wire on poles along the road through Nashua and Pearl Rock. In places the poles were torn out of the ground, the wire pulled from the poles and twisted into every possible shape, whole spans of it being compressed into 2 or 3 foot lengths. The company estimated their loss in material to be $6,000. None of the recovered wire can be used again and much of it has not yet been located.

METEOROLOGY IN NORWAY FOR 50 YEARS.[1]

[*Review reprinted* from Nature, London, Mar. 14, 1918, **101**: 26-27.]

The volume before us, published in celebration of the 50 years' existence of the Norwegian Meteorological Institute, commences with brief sketches of the lives of Prof. Henrik Mohn and Director Aksel Steen, to both of whom the institute, to a large extent, owes its development. A very interesting account is given of the history of meteorology in Norway. Owing to the peculiar geographical position of the country, meteorology was early found to be of special importance and observations were taken from the end of the seventeenth century; but it was not until the beginning of the nineteenth century that regular observations in the modern sense of the word were commenced. In 1811 Prof. Esmarck began them in Christiania, and in 1837 Prof. Hansteen took daily observations of pressure, temperature, wind direction, and force, cloud amount, and appearance of the sky. A scheme was then put on foot for organizing daily observations in the different parts of the country, but these gradually fell off, until in 1850, with the exception of the unbroken records at Christiania, meteorological work in Norway was almost at a standstill.

It was the great storm of 1854, which overtook the French and English fleets on the Crimean coasts, that gave a new impetus to meteorology in Europe, and in

[1] *Norway Meteorologiske Institut.* Meteorologien i Norge i 50 aar: Festskrift utgit av det Norske meteorologiske institut i anledning av dets 50-aars jubilaeum, 1. December, 1916. Kristiania, 1917. 138 p. illus. 28 cm.

1855 Le Verrier made proposals for an international weather service. Norway was greatly interested in the new movement, and in 1860 C. Nielsen, director of telegraphs in Norway, established five stations along the coast—Christiansund, Aalesund, Skudenes, Mandal, and Sandøsund—with the necessary instruments and staff. At these stations observations were made three times daily of pressure, temperature, humidity, wind, weather, and cloud. A short time later an inland station was established at Dombaas, and reports were exchanged between these stations and Sweden, and also, after a few years, with Paris.

The six stations were soon found to be insufficient for the proper development of meteorological work in Norway, and in 1865 it was resolved to erect a meteorological institute and to appoint a professor of meteorology. The institute was commenced, and in 1865 Henrik Mohn was appointed professor of meteorology and director of the meteorological institute. New instruments were installed at the existing stations, and on December 1, 1866, the Norwegian Meteorological Institute began its operations, with the cooperation of the six stations mentioned and also of Bergen and Christiania.

Prof. Mohn's initiative soon resulted in great developments. The number of climatological stations was rapidly increased; in 1871 there were 55, in 1898, 80. The collection of rainfall statistics also interested Prof. Mohn greatly, and by 1890 he had established nearly 100 stations. In 1895 the number reached about 300, and a few years later 500 stations reported rainfall to the institute.

The international exchange of telegrams was also developed. As early as 1869 telegrams were received from Great Britain. Denmark commenced in 1871, Sweden in 1873; Russia, Finland, Germany, and France began in 1892, and the Faroe Islands in 1907. Spitzbergen, Austria-Hungary, and Italy joined in 1912, followed in 1913 by Holland, Spain, Portugal, and Madeira.

Meanwhile the telegraphic reporting of observations from Norwegian stations was increased. By 1892, 33 stations reported by telegraph, while by 1914 the number had increased to 69.

Services of storm warnings and forecasts were commenced early in the history of the institute. The reports and publications were organized and developed, and the volume gives diagrammatic representations of the growth of the institute's reporting stations, staff, budget, and library.

Aerology received much attention at the beginning of the present century. Sounding balloons were sent up, and in 1909 pilot balloon ascents were begun. In 1912 this part of the work was taken over by Prof. V. Bjerknes, and it is now carried on by the observatory at Aas.

Notes are given on the past and present members of the staff of the institute and detailed descriptions of the growth and work of each of the three sections dealing with climatology, forecasting, and rainfall respectively. The establishment and work of the observatories at Aas, Bergen, and Haldde are described, and the book is illustrated by interesting photographs of the institute and observatories and by reproductions of charts and diagrams.

FREQUENCY OF SNOW IN TRIPOLI AND ALGERIA.

[*Reprinted from* Nature, London, Jan. 3, 1918, **100**: 350.]

Prof. Filippo Eredia has recently published in the *Bollettino d'Informazione* of the Italian colonial office a useful note on the frequency of snow in Tripoli and in Algeria. In the last-named country, at sea level, snow is rare, since only one fall in the whole year may be expected. At a height of 600 meters, 6 falls per annum occur on the average, while at double this elevation, 25 falls are experienced. In Algeria and Tunisia the most frequent and extensive snowfalls occurred in the winter of 1890–91, while 1884, 1904–5, 1913, and 1915 were also characterized by abundant snowfalls. Some interesting photographs are given of snow scenes in Tripoli during the snowstorms of February, 1913, and February, 1915.

"PRAYING" PALM TREE OF FARIDPUR.

[*Reprinted from* Nature, London, Mar. 28, 1918, **101**: 70.]

The [Indian?] *Pioneer Mail* of January 11 reports a lecture by Sir J. C. Bose on "The Praying Palm Tree" of Faridpur. While the temple bells call the people to evening prayer this tree has recently been seen to bow down in prostration and to erect its head on the following morning. Large numbers of pilgrims have been attracted to the place, and offerings to the tree are said to have been the means of effecting marvelous cures. Sir J. C. Bose first procured photographs which proved the phenomenon to be real. The next step was to devise a special apparatus to record continuously the movement of the tree by day and night. The records showed that it fell with the rise of temperature and rose with the fall. The records obtained in the case of other trees brought out the fact that all the trees are moving, each movement being due to changes in their environment.

"SUMMER TIME" IN 1918.

[*From* Nature, London, Mar. 14, 1918, **101**: 27.]

Summer time began in France and Italy on March 10; it begins in Great Britain on March 24, and will begin in Holland on April 1. The dates on which summer time ends are also different in different countries. However, much "daylight saving" by alteration of clocks may be appreciated by the public, there can be no doubt that the varying dates adopted for the beginning and ending of the change of standard are most confusing, and will render it very difficult to determine the exact instant at which any records of observations of natural occurrences are made.

RUSSIA ADOPTS THE GREGORIAN CALENDAR.

[*From* Nature, London, Feb. 21, 1918, **100**: 488.]

We learn from a message from the Petrograd correspondent of the *Times*, published in the issue of February 20, that the abolition of the Julian calendar and the substitution of the reformed, or Gregorian, calendar has been formally announced by the Government of the People's Councils. "Attempts from the time of Peter the Great to effect this reform have always failed through ecclesiastical opposition, but now that the Orthodox Church has been divorced from the State its opinions and traditions are entirely ignored."

DIURNAL VARIATION OF ATMOSPHERIC PRESSURE.

[*Abstract reprinted from* Nature, London, May 30, 1918, **101**:253–254.]

The effect of geographical latitude on the semidiurnal wave of atmospheric pressure is fairly regular and well marked, but the variation of the diurnal wave has at-

tracted less attention since Angot in 1887, and also Hann, showed conclusively its dependence on secondary local conditions. Three Japanese investigators from the Geophysical Seminary of the Physical Institute, Tokyo, contribute an account [1] of a preliminary attempt to trace more definitely the mechanism of these local influences, one of the most obvious of which, under the name of "continentality," has recently been attracting the attention of Mr. C. E. P. Brooks in this country in connection with climate, and with a purely geographical theory of the ice age.

The elementary definition of continentality as the percentage of land in a circle of definite size (say 10° radius) surrounding the station is clearly insufficient, so much depending upon the orientation and shape of the coast line or lines that the form of the function is bound to be complicated. The Japanese authors soon come to the conclusion that it is not linear, and are constrained to make a series of simplifying assumptions in order to reach a workable hypothesis. The assumptions are no more probable than those of the early days of the theory of tides, with which the present problem has obvious analogies.

With these limitations the authors appear to account for such features as the variation with longitude, the inversion of phase near the poles, and the minimum amplitude near the coast, but a general solution of the problem has evidently not yet been reached. They indicate the lines on which they propose to continue the investigation, and conclude with a representative set of daily variation curves for 10 British observatories, showing considerable dissimilarity, those of Oxford and Aberdeen, for instance, being almost the converse of each other. A systematic series of stations within the Empire, chosen with special reference to the elucidation of this problem, may well form part of the program of coordinated British Empire meteorology so strongly advocated by Maj. Lyons in his presidential address to the Royal Meteorological Society.

The barometric variations dealt with in the above paper, as generally studied, are naturally to be regarded as vertical oscillations of the free atmosphere, though there is a possible difficulty in the differentiation between statical and dynamical pressure, when an ascending or descending current is in question. But there is also a very decided horizontal oscillation or motion of the free atmosphere, and this has begun to attract attention since the use of pilot balloons has provided more information about the direction of the wind at different heights than can be inferred from the motion of clouds. A paper from Batavia [2] has appeared in the Proceedings of the Royal Academy of Amsterdam dealing with the semidiurnal variation of this motion.

There is a good deal of uncertainty about the investigation, even in a favorable place like Batavia, where atmospheric conditions are as a rule very quiet and steady. Observations were made not only at Batavia, but also at a neighboring mountain station of 3,000 meters elevation, as well as from a small coral island, to eliminate the land effect. Single observations are included, specially at times of the day when convection currents are not in evidence in the lower atmosphere; otherwise double observations by day and by night were obtained with different base lines of approximately one-half mile, 1 mile, and 1½ miles in length. Some hundred of ascents were observed, of which a fair proportion reached a height between 9 and 11 kilometers, only 30 per cent failing to reach the 4-kilometer level.

The data are admittedly insufficient to determine a diurnal oscillation, but Dr. van Bemmelen is fairly satisfied with the result for the semidiurnal one. The east and north components are treated separately, and it is found that the former has a greater amplitude than the latter and also a better determined phase. Gold's theoretical results for the lower layers are confirmed (Phil. Mag. vol. 19). The phase of the east component diminishes up to 4 kilometers, and probably increases above that height, showing a fairly close analogy with the vertical oscillations.— *W. W. B.*

[1] *Terada, T., Kiuti, M., & Tukamoto, J.* On diurnal variation of barometric pressure. Jour., Coll. sci., Imp. univ. Tokyo, November 20, 1917, **41**, art. 1.

[2] *Van Bemmelen, W., & Boerema, J.* Semidiurnal horizontal oscillation of the free atmosphere up to 10 kilometers above sealevel, deduced from pilot-balloon observations at Batavia. Proc., Roy. acad., Amsterdam, 1917, **20**:119-135, plate.
See also the abstract in this REVIEW, January, 1918, **46**:22.

SPRING OF 1918 IN THE BRITISH ISLES.

[*Reprinted from* Nature, London, May 9, 1918, 101: 190-191.]

Spring this year has somewhat resembled that of last year, except that the early days of May this year have been much colder. The reports issued by the Meteorological Office show that the cold spells which have prevailed with such persistence in London have been common over the whole of the British Islands. March was, for the most part, dry, mild, and sunny; the mean temperature at Greenwich was 44°, which is 2 degrees above the average, and 5 degrees warmer than March, 1917. The mean temperature for April this year was 45°, which is 3 degrees below the average, but 2 degrees warmer than April last year. The warmest week since the commencement of spring is the week ending March 23, when at Greenwich the mean temperature was 48.2°, which is 5.4 degrees above the average. The week with the greatest deficiency of temperature is the week ending April 20, when the mean was 40.4°, with a deficiency of 6.9 degrees; during this week the rainfall at Greenwich measured 1.79 inches, which is 0.2 inch more than the average for the whole month. In London, at Tulse Hill, in a Stevenson's screen, the maximum thermometer only rose to 60° or above on three days in April, and the highest temperature was 63°; while in March there were seven such warm days, and the highest temperature was 69°. April this year was peculiarly sunless, and this, coupled with the low temperature, kept vegetation throughout the month greatly at a standstill.

DANISH REPORT ON ARCTIC ICE DURING 1917.

[*Abstract reprinted from* Nature, London, May 30, 1918.]

The Danish Meteorological Institute has published its report for 1917 on the state of the ice in the Arctic seas (Isforholdene i de Arktishe Have). War conditions have made it impossible to obtain as full reports as usual except from the coasts of Greenland, Iceland, Spitzbergen, and the Barents Sea. In Spitsbergen and the Barents Sea the ice conditions were again abnormal and most unfavorable. The winter ice in Spitsbergen fjords broke up a month later than usual, and the autumn ice formed several weeks ahead of the average date. There was pack ice off the west coast of Spitsbergen throughout the summer months. The coast was most approachable during the first half of August and the second half of September. Throughout the summer it seems, as usual,

to have been easier to enter King's Bay than fjords farther south, but until late in July the pack on the west coast of Spitsbergen more or less met the pack of the Greenland Sea, and on this account it was not easy to reach the open water north of Prince Charles Foreland. Storfjord seems to have been clear of ice in September, and possibly in August. Reports from the Kara Sea are scanty, but the ice conditions there seem to have been bad. No vessel attempted to make the passage in 1917.

RAINFALL IN MYSORE DURING 1916.

[*Abstract reprinted from* Nature, London, May 30, 1918.]

The report on rainfall registration in 1916 in Mysore includes maps showing the actual rainfall for the year 1916, and the average annual rainfall for the period 1870–1915. On June 25, 1916, more than 16 inches of rain fell during 24 hours at Nagar in the Shimoga district; the total rainfall at that place during June was 38 inches, nearly 50 per cent above the normal, although the total fall for 1916 was practically normal at 104 inches. The rains during October and November, 1916, were above the normal on account of an exceptional number of cyclonic storms, which originated in the Bay of Bengal. The rains were on the whole but half of the normal during the cool-weather period, January and February, and also during March, the beginning of the hot-weather period. The deficiency was more than made up during the rest of the year, especially in the northeast monsoon period from October to the end of the year. The tables occupy 58 pages and give the details for the 224 stations under various heads; a notable table is that which gives the distribution in the river valleys.

CLIMATIC NOTES ON PALESTINE, MESOPOTAMIA, AND SINAITIC PENINSULA.

[*Abstract reprinted from* Nature, London, May 30, 1918.]

Weather controls over the fighting in Mesopotamia, in Palestine, and near the Suez Canal is the subject of an article by Prof. Robert DeC. Ward, of Harvard University, in the *Scientific Monthly* (New York, April). Mesopotamia is characterized as "a country of aridity, of intense summer heat, of deserts and steppes, of relatively mild winter, and of cold-season rains." The mean temperature at Bagdad for January is given as 48.7° F., and for August 92.5°; the mean maximum is 119.5°, and the mean minimum 21.9°, which are the mean extremes in the year. Winter frosts occur and snow falls locally. The total mean annual rainfall is only about 8 or 9 inches, and in some years only about half as much. The rain falls between October and May, and the remaining months are practically rainless. February or March is the rainiest month, and the floods come in March and April. The climate of Palestine has been discussed by Exner and Hann, and the article quotes various data. The coast stations have a mean midwinter temperature of between 50° and 55° F., and mean midsummer temperature of 75° to 80°. The hill stations, at elevations of about 1,500 to 3,000 feet, have mean midwinter temperatures from 45° to 50°, and midsummer means from 70° to a little under 80°. In the Jordan Valley the temperatures range from 55° in midwinter to 85° or 90° in midsummer. Jerusalem averages 3.6 days a year with temperature below freezing, and the highest summer temperatures reach 100° to 105°. The annual rainfall at the coast stations ranges from 15 inches to 35 inches, and at Jerusalem it is 26 inches, no rain falling in June, July, and August. The rainy season extends from the middle of October to early in May. In the district of the Suez Canal the complete absence of rain for months together and the exceptionally small total annual fall in places immensely augments the difficulty of transport. Prof. Ward says that winter is the best season for a campaign, both on account of the better water supply and of the lower temperature.

CLOUDS AT THE ROYAL ACADEMY.

By J. S. D[INES].

[*Reprinted from* Nature, London, May 30, 1918, 101: 245.]

The smoke and haze which commonly obscure the sky in large cities, and the otherwise restricted outlook, allow the town dweller inadequate opportunities for the study of clouds, but to those who live in the country, and to the observant worker in a town when spending a holiday away from his native place, the ever varying cloud effects form quite as attractive an object of interest as the countryside itself. This being so, it might be thought that in landscape scenes artists would devote at least as much attention to the sky and the clouds above as to the hills and valleys below. That this is not the case will be painfully evident to the meteorologist, or even the ordinary intelligent observer of Nature, who visits the Royal Academy and makes but a cursory examination of its walls. Let it be granted at once that there are notable exceptions, but the conclusion can not be resisted that to many artists the clouds form a very subsidiary part of the picture, and are put in to produce what to the artist's eye is presumably a pleasing effect, but without the least regard to natural truth.

The majority of the clouds appearing in this year's exhibition belong to the strato-cumulus or fracto-cumulus type, though, as would be expected, the hard convection cumulus, the most striking of all clouds, is not neglected. Perhaps the most remarkable feature is the almost entire neglect of high clouds of the cirrus and cirro-cumulus types, which produce some of the most beautiful effects in Nature. Cirro-cumulus is shown in one or two sunset pictures, and a not entirely successful attempt has been made in one case to depict the sun shining feebly through an alto-stratus veil; but true cirrus is almost entirely unrepresented. In "The Passing of Autumn" (91) the meteorologist may think that he detects a fragment of false cirrus showing up against a rather fine cumulus, but the remaining clouds in this picture spoil what might otherwise have been a successful cloud study. True cumulus should surely be a cloud type which would lend itself to the artist's needs without any departure from the forms provided by Nature, but in many cases these clouds are given the most grotesque and unreal shapes, which completely spoil the picture to the observant lover of the country.

On the other hand, some of the most successful clouds in the exhibition appear in B. W. Leader's "The Weald of Surrey" (51) and A. R. Quinton's "The Road over the Downs, Sussex" (695), where clouds of the cumulus and strato-cumulus types are both true to Nature and blend admirably with the peaceful scenes depicted. Less peaceful, but with an equally admirable effect, is A. W. Parsons's "Rolling from the West" (196), where similar

clouds are depicted over the sea. In the most prominent picture of the second gallery, "Cader Idris" (87), H. Hughes-Stanton includes clouds of the cumulus type which in their hard outlines and rather unnatural coloring, are very jarring when inspected from any of the nearer parts of the room, but if the picture is viewed from the greatest distance possible the effect becomes more attractive and the lights and shadows of the clouds blend into one another in a more harmonious whole. A very similar effect is produced in the smaller work by the same artist, "Welsh Hills near Barmouth" (602).

When looking at a wide stretch of country, whether it be an extensive plain as seen from the top of a range of hills, or the hills and valleys of a mountainous country viewed from some vantage point, the most attractive effects are often obtained on a day when the sky is covered with detached clouds of the cumulus type, causing a bright contrast between the light and shade on the country below. A scene of this kind is depicted by Bertram Priestman in "The Walls of Langstrothdale" (114), but to the critical observer the whole is spoiled by the unreality of the clouds themselves, though the shadow effect on the ground is more successful. The only type of cloud which is almost uniformly well dealt with is where the "clouds" appear as mountain mists, and one concludes that artists must subject this type to much more study than the clouds in the sky above. Some of these mountain mist effects are notably good. "The Head of the Glen," by Peter Graham (439), and "Yarrow: 'The Vapors Linger Round the Heights,'" by Alfred Parsons (126), may be mentioned among others in this connection. In "Easedale Tarn, Westmorland" (207), J. H. Crossland has shown us clouds over a mountain top which are delightfully real.

Attempts to indicate showers passing over a landscape generally lead to a more successful portrayal of the dark falling rain in the shower than of the cumulonimbus cloud above. This appears to be a subject that might give far more realistic and attractive results than any shown in this year's exhibition. "The Gravel Pit," by Arthur Friedenson (583), seems to be the most successful of those exhibited. The high cloud at sunset in B. W. Leader's "Still Evening" (175) raises an interesting speculation as to the probability of the conditions shown being true to life. Bands of high cloud are brightly tinted pink in the rays of the setting sun, whereas other clouds in the same part of the sky, but at an apparently higher level, are illuminated, but without color. The writer does not remember a case of this kind coming under his observation, although it appears not to be impossible. The interesting and quite common case where the high clouds are illuminated with a pink glow, while the lower ones have already passed into the shadow of the earth, does not seem to have attracted the artist's imagination. Very interesting information as to the relative heights of different cloud layers may sometimes be obtained in these circumstances.

Observers often, in dealing with Nature herself, have difficulty in deciding to which of the artificial types of the international classification a cloud belongs, so infinite are the varieties which occur, but all meteorological observers who visit the academy will undoubtedly give a sigh of relief that they are not expected to classify the strange shapes which appear in the sky in "Evening" (233), to mention one case only, though it does not stand alone. In "Wind from the South" (383) the artist presumably set out to portray falling snow; but surely with a title so meteorological he might have given more careful attention to the meteorological elements in his picture. Finally, all who hold that gunfire has an influence on rainfall should undoubtedly visit the academy for confirmation of their views. If the clouds over the battlefields of France really take the forms shown in some of the pictures (notably "Dawn," 333), few will have the hardihood to maintain that the rainfall or even the entire climatic conditions of the neighborhood may not be seriously affected.

Grove Karl Gilbert, 1843—1918.

Dr. Grove Karl Gilbert, one of the charter members of the Washington Academy of Sciences, died at Jackson, Mich., on May 1, 1918, within a few days of his 75th birthday (May 6, 1843). He had been asociated with the scientific life of Washington for 47 years, having been geologist of the Wheeler and Powell surveys in 1871 and 1874, and one of the original staff of the present United States Geological Survey at its establishment in 1879. Dr. Gilbert was a member of the Geological Society of Washington, of which he was president in 1895 and 1909; the Philosophical Society of Washington, of which he was president in 1892; the National Academy of Sciences; and many other American and foreign scientific organizations. His broad-minded interest in the problems of the earth kept him an active investigator throughout his life, and his published papers cover almost the entire range of modern geological science.—*Jour., Wash. Acad. Sci., June 4, 1918, p. 379.*

Dr. Gilbert was not directly occupied with meteorological problems as such, but one of his early papers bore directly on the problem of the deflection of winds on a rotating earth; while his classic monographic study of the shorelines of the Pleistocene lake named after Bonneville could not but lead him to a study of the prevailing winds of a prehistoric geological epoch. Again, his studies on changes in levels of the Great Lakes revealed a tilting that must be taken account of in any study of very long period oscillations in the lake levels due to precipitation (see this REVIEW, April, 1898, p. 164)[1].—Editor.

Yudzi Wada, 1859–1918.

Dr. Y. Wada, director of the Korean meteorological service established in 1904 by Japan after the Russo-Japanese War, died after a brief illness on January 5, 1918. Dr. Wada was born September 29, 1859, in Nihonmacu; early learned the French language; graduated from the Imperial University of Tokyo with the title Rigaksi in 1879, having specially devoted himself to physics. On graduating he entered the Geographical Office—then including the work of the present Central Meteorological Observatory—where he was occupied with geodesy, astronomy, and meteorology. In 1882 he began his activity as a weather forecaster for the Japanese hurricane service then under E. Knipping; later he continued this work alone as chief of the forecasting service. In 1890–1892 he visited the Parisian universities and observatories for purposes of study; and on the Japanese occupation of Korea and southern Manchuria in 1904 he

[1] *See also* his paper "The water level of Great Salt Lake," this REVIEW, January, 1901, **29**: 23–24, for a discussion and interpretation of lake-level fluctuations.

was put in charge of the establishment of Japanese meteorological stations there. Some account of the Japanese service in Korea is given by his own hand in this REVIEW, September, 1905, pages 397–399, accompanied by a portrait. He was one of the founders of the Meteorological Society of Japan.

Wada received the degree of Rigakhaksi from the Imperial University of Tokyo in 1913. His official military rank was that of brigadier general, and his decorations included those of Order of the Rising Sun, Fourth Class; of The Sacred Treasure, Third Class; and of Hakke, Second Class.[1]

HALLEY LECTURE OF 1918 AT OXFORD.

The annual Halley lecture was delivered on May 28 by Sir Napier Shaw, director of the Meteorological Office. The subject was "The First Chapter in the Story of the Winds." The lecture, illustrated by lantern slides, dealt with Halley as the first framer of a physical explanation of trade winds and monsoons. His views still in part hold good, but the phenomena are more complicated than Halley thought. Contrary to what was once surmised, observation has shown that the horizontal circulation of the air is explicable, the vertical circulation being too complex for exact determination at present, though progress may be hoped for in this direction.—*Nature, London, May 30, 1918.*

NOTES.

The Royal Society of Edinburgh has awarded its Keith prize to Mr. R. C. Mossman for his work on the meteorology of the Antartic regions, which originated in the series of observations made by him during the voyage of the *Scotia* in 1902–1904, and has continued to the present time.—*Nature, May 9, 1918, p. 189.*

Nature announces the death, on March 22, 1918, of Mr. Donald Salter, from wounds received in action. Mr. Salter joined the staff of the British Rainfall Organization at 18 years of age, in 1908, and was the responsible cartographer for the numerous rainfall maps since published by it.—*Nature, May 9, 1918, p. 190.*

The Cambridge Scientific Instrument Co., Cambridge, England, is publishing, free on receipt of 6d. in stamps, a very useful spiral chart comparing and interconverting Fahrenheit and centigrade thermometric scales throughout an unusually long range of temperature, by 2° intervals.—*Nature, May 9, 1918, p. 192.*

Dr. Griffith Taylor, who received the Thomson Foundation medal from the Royal Geographical Society of Queensland last year, has been awarded the David Syme research prize (medal and £100) for 1918 by the University of Melbourne, his thesis being the correlation of Australian physiography, meteorology, and climatology with special reference to the control of its settlement and industrial development.

The David Syme prize is awarded annually by the University of Melbourne for the best Australian research on any subject, and the contestants must have resided in Australia for the preceding five years. Dr. Taylor has also been appointed instructor in Australian meteorology and geography in that university, and his lectures are to be, probably, the first course of the sort in any of the Australian colleges and universities.—*Personal correspondence and "The Age," Melbourne, May 2, 1918.*

Nature (London) of May 30, 1918, reports that the lords commissioners of His Majesty's treasury have approved the proposal of the meteorological committee that, in view of the variety and importance of the scientific problems on which the meteorological office is required to advise the fighting forces, Sir Napier Shaw shall, for the period of the war, become scientific adviser to his Majesty's Government in meteorology, and be relieved of the administrative duties of the meteorological office, but retain the chairmanship of the meteorological committee. Lieut. Col. H. G. Lyons has been appointed acting director of the meteorological office for the same period.

"* * * * The value in war of correct forecasts is obvious, but there are many other ways in which an intimate knowledge of meteorology may be of use, and no more suitable man [than Sir Napier] could have been found for the new post."

[1] Based, in part, upon notice with portrait in Journal of the Meteorological Society of Japan, February, 1918, 37th year.

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR MAY, 1918.

By H. C. FRANKENFIELD, Supervising Forecaster.

[Dated: Washington, June 4, 1918.]

GENERAL PRESSURE DISTRIBUTION OVER THE NORTHERN HEMISPHERE, EXCEPT EUROPE AND ASIA.

The observations taken at Midway Island and Honolulu, T. H., indicated a condition of sustained low pressure at the latter and a nearly normal one at the former place after the first decade of May, 1918, when pressure was moderately high except between the 5th and the 7th. Pressure over the Aleutian Islands and Alaska was almost uniformly above the normal, except during the first five days and at the end of the month, with a marked crest over the Aleutians from the 13th to the 21st, inclusive.

Over the United States proper low pressure was the rule after the first few days, except in the Atlantic and Gulf States where it was somewhat above the normal during the second half of the month. The limits of fluctuation were not great.

Over the North Atlantic Ocean pressure was high from May 2 to 30, inclusive, except over the southern portion where it was nearly normal.

WARNINGS FOR THE WASHINGTON DISTRICT.*

Storm warnings.—On the morning of May 1 there was a disturbance off the southern New England coast, moving northeastward with increasing intensity, and at noon northeast storm warnings were displayed on the eastern Maine coast, with orders to change to northwest at sunset. Only fresh winds occurred, however, and the warning was not justified. (See Chart XLVI–42 for movement of LOWS.)

On the morning of May 7 a northwestern disturbance was central over Lake Superior with increasing intensity, and at 10 a. m. southwest storm warnings were ordered for Lakes Erie and Ontario, strong southwest and west winds with gales on Lake Erie being indicated during the afternoon and night. Gales occurred as forecast except on Lake Ontario. At 8 p. m. of the 7th the storm was central over Ontario, still moving eastward, and at 10 p. m. southwest storm warnings were ordered on the Atlantic coast from Delaware Breakwater, Del., to Boston. Strong southwest to west winds were expected to blow during the early morning of the 8th, shifting to northwest during the day. This warning was but partially verified, as there were no strong winds except on the southern New England coast.

On the morning of May 9 a marked disturbance from the middle Plateau Region was central over western Nebraska, accompanied by rapidly falling pressure to the east, and at 11 a. m. northeast storm warnings were ordered for Lake Superior and the northern portions of Lakes Michigan and Huron. At the same time southwest warnings were ordered for the southern portions of Lakes Michigan and Huron and at Detroit and Toledo. At 3 p. m. southwest warnings were extended on the lower Lakes from Sandusky to Buffalo. These warnings were fully verified except on western Lake Superior, the maximum wind velocities ranging from 32 to 60 miles an hour. On the morning of May 10 northwest storm warnings were ordered on Lake Ontario, and the warnings on eastern Lake Superior, northern Michigan, Huron, and Erie were changed to northwest with instructions to lower at sunset on Michigan and Superior. By this time the storm was central over Ontario, retaining its marked form, and at 11 a. m. southwest storm warnings were ordered on the Atlantic coast from Norfolk, Va., to Eastport, Me., in anticipation of strong southwest winds that would shift to west and northwest by the following morning, probably reaching gale force. These warnings were also verified, although the winds did not quite reach gale force along the Atlantic coast.

On the evening of May 14 pressure was falling rapidly over the West, and at the same time was quite high over the northern upper Lake Region; accordingly northeast storm warnings were ordered at 10 p. m. on Lake Superior for strong easterly winds on the following day. This warning was partially verified, strong winds occurring over the central and eastern portions of Lake Superior.

On May 16 there was another marked depression over the Northwest with a quite strong gradient southeastward, and after the receipt of special observations southwest storm warnings were ordered at 5 p. m. for Lakes Superior, Michigan, and northern Huron. Strong south to southwest winds were indicated, with a shift to northwest on the following day over western Lake Superior. This disturbance did not develop as had been expected, there were no strong winds except over central Lake Superior, and warnings were lowered at 10 a. m. of the 17th.

On May 21 another Plateau disturbance was central over western Nebraska with strong high pressure to the northeast, and at 10 a. m. northeast storm warnings were ordered on Lake Superior from Duluth to Eagle Harbor, Mich. This warning was verified by the occurrence of a wind of 42 miles an hour from the northeast at Duluth.

There were several small-craft warnings ordered during the month for local fresh winds. None was of consequence.

Frost warnings.—The North Atlantic coast disturbance on the morning of May 1 was followed by an extensive cold, high-pressure area (see Chart XLVI–41) accompanied by heavy to killing frosts in the upper Mississippi Valley and the upper Lake Region. Frosts were forecast for the following morning for the Ohio Valley, central and eastern Tennessee, the lower Lake Region, and the Atlantic States from New England to the interior of South Carolina and Georgia, with heavy frosts expected north of Maryland and Delaware. These frosts occurred as forecast, except in Georgia and central South Carolina. As pressure was still very high on the morning of the 2d in the Ohio Valley and the lower Lake Region, frosts were again forecast for the mountains of Maryland and West Virginia, interior of Virginia and North Carolina and for the cranberry district of New Jersey.

* Time used in this discussion is "summer time" throughout.

These warnings were not well verified, although frost occurred on the 3d in extreme western North Carolina and temperatures below freezing in the cranberry bogs.

On the morning of May 8, following a well-defined disturbance over New England, frosts were forecast for northern New England, the western portion of eastern New York, and interior of western New York; but owing to rapidly falling pressure in the West during the following night there was but little fall in temperature and no frosts were reported except from the western portion of western New York.

On the morning of May 10, with a severe disturbance over Ontario and rapidly rising pressure to the westward, frosts were forecast for the upper Lake and western lower Lake Region. Frosts occurred on the following morning over the greater portion of the area for which they had been forecast, except Ohio. On the morning of May 11, frost warnings were extended eastward to southern New England, interior eastern New York, and the cranberry bogs of New Jersey, if the weather cleared. This it did not do, as the rapid approach of a disturbance from the southwest created a general condition of cloudiness by the following morning, by which time low pressure prevailed over the Central Valleys and the Lake Region, followed by a rapid local rise in the Northwest which appeared to indicate frosts or freezing temperature for the following morning in upper Michigan. Warnings to that effect were accordingly issued and were verified by the occurrence of heavy frost and of freezing temperatures on the morning of the 13th. At this time, although conditions were much unsettled over the central valleys, temperatures were quite low with rising pressure, and frost warnings were therefore issued for Michigan, northern and central Indiana, western Pennsylvania, and Ohio. These warnings were not verified except in lower Michigan, although temperatures close to freezing occurred in upper Michigan.

Local frost warnings for limited localities were also issued on the 15th, 20th, 21st, 22d, and 23d. A majority were verified, although none was of consequence.

WARNINGS FOR OTHER DISTRICTS.*

Chicago, Ill., forecast district.—The most important warnings issued during May were the sheep warnings for Montana and Wyoming on the 8th, and for Wyoming on the 25th. They were fully verified, as snow and freezing temperatures ensued within 24 to 30 hours. A similar warning for Montana on the 14th was not verified.

Warnings of frost or freezing temperature were issued on the 9th for the Northwestern States and frost for the western portions of Nebraska and Kansas. These warnings were mostly verified. Frost warnings were also issued for the upper Mississippi Valley on the 12th and north and central Wisconsin on the 22d. These were verified. No warnings of importance were issued during the remainder of the month.—*Charles L. Mitchell, Forecaster.*

New Orleans forecast district.—The prevailing high barometric pressure over the Eastern and Southeastern States and the depressions that were over the central districts for the most of May, 1918, resulted, as a rule, in mild summerlike weather. No severe storms occurred and conditions requiring warnings were confined to the first 11 days.

A southeast storm warning was issued for the Texas coast east of Matagorda Bay, on indications of the 8 p. m. map of the 5th. A secondary depression was central over the Texas Panhandle and a moderately steep barometric gradient extended over Texas. The warning, which was justified by the occurrence of a moderate gale, was lowered the next morning, as conditions rendered it no longer necessary.

A small-craft warning was issued for the Texas coast on the 11th and was justified.

Light frost in northeastern Arkansas was forecast on the 1st and occurred as predicted. The frost warning of the 10th, issued for northeastern Oklahoma and northern Arkansas, failed of verification owing to the strong development of a depression from the Southwest.—*R. A. Dyke, Forecaster.*

Denver, Colo., forecast district.—The month was marked by a persistency of low pressure throughout the district with ill-defined and shifting LOW centers. Two slight interruptions to this distribution of pressure occurred in the extreme northern part of the district, bringing moderate precipitation, but elsewhere droughty conditions prevailed. Warnings of freezing temperatures and heavy frosts were issued on May 10, 11, and 12 for parts of Colorado, and for light local frosts on a number of dates in different parts of the district until the end of the month.

From the 6th to the 8th an extensive low-pressure area occupied the interior of the country west of the Mississippi. During the 8th the depression assumed a definite form with its center over Colorado, while a high-pressure area was in course of development in Alberta. On the morning of the 9th the depression, which had deepened, was central in western Nebraska. This storm moved northeastward during the next 12 hours, while the front of the high-pressure area spread southward along the eastern Rocky Mountain slope, attended by snow in north-central Colorado and freezing temperature in the northeastern quarter of the State. Fortunately, vegetation in that part of Colorado was too backward to be injured by the low temperatures. During the 9th a depression formed in the eastern parts of Utah and Arizona, and under its influence the pressure along the southern front of the high-pressure area that overlay the eastern slope on the 10th fell rapidly, permitting the southeastward movement of the depression to New Mexico and Texas. With the change in the position of the LOW center, skies cleared in the North Fork and Uncompahgre districts in western Colorado. Special warnings were sent direct to the growers at 8 p. m. of May 11, and practically all equipped for orchard heating utilized the information. The next morning, the 12th, temperatures were still below freezing in the North Fork and Uncompahgre districts, but in the Grand Valley, which had escaped freezing weather the preceding night, temperatures fell decidedly, the readings in the orchard districts ranging from 24° to 34°.—*Frederick H. Brandenburg, Forecaster.*

San Francisco, Cal., forecast district.—May, 1918, was a quiet month on the Pacific slope. All storms passing inland from the Pacific during the month entered the continent at a very high latitude and passed through the British possessions. Secondary depressions formed in the southwestern quadrant of several of these storms, either in British Columbia and moved south over the Plateau Region to the valley of the Colorado, or formed over the latter section, and thence moved eastward. These caused the only precipitation occurring in the district.

* Time used is "summer time" for respective time zones.

No storm warnings were ordered, but small-craft warnings were issued on the morning of the 2d for the mouth of the Columbia River, Strait Juan de Fuca, and Gulf of Georgia, and were justified.

Live-stock warnings were issued on the morning of the 15th, in eastern Oregon, Idaho, and Nevada. The warning read:

To-night and Wednesday showers; colder for the next few days with strong gusty westerly winds. Notify stockmen.

This warning proved timely, as there was a marked fall in temperature in the specified districts during the ensuing 24 hours. As sheep shearing was at its height at this time, it is believed the warning was of great benefit to the stockmen.

The month was cool and there were a number of mornings when heavy to killing frosts occurred in the Plateau Region causing damage to fruit and garden truck. Frost also occurred in limited areas in the northern coast counties of California, causing some damage to vineyards. Warnings of frost were issued in Nevada, Idaho, and Washington and Oregon, except near the coast, on the 5th, 6th, 9th, 10th, 21st, and 23d, and were generally verified.

Light rains occurred in the first and second decades in Washington and western Oregon, and showers in the second and third decades in Idaho and Nevada. Scattered light showers occurred in California on the 8th, 9th, and 27th. The rainfall was deficient over the entire district and crops are suffering from a lack of moisture.—*G. H. Willson, forecaster.*

SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS, MAY, 1918.

By ALFRED J. HENRY, Meteorologist.

[River and Flood Division, Weather Bureau, July 1, 1918.]

There were no severe floods during May, 1918, but in a number of States local floods caused the rivers to overflow the lowlands, causing more or less loss to agricultural interests on account of cost of seed and labor of replanting. As shown in detail by tables below, it will be noted that there were some overflows in the rivers of Arkansas, eastern Kansas—although the overflow was not great in that State—Indiana, Ohio, and Missouri. A freshet occurred in the Guadalupe River of Texas, also in the lower Rio Grande in the first decade of the month. Serious damage was not done.

The Mississippi in the stretch between Hannibal and Louisiana, Mo., reached the flood stage at the end of the month and remained at a relatively high stage during June. Heavy rain over the drainage area above Hannibal caused floods throughout June, to which further reference will be made in the June REVIEW. No material damage resulted from May floods in the middle Mississippi.

A summary of losses by river districts follows.

Estimated loss by flood, May, 1918.

River district.	Tangible property: Bridges, etc.	Crops, prospective.	Live stock.	Suspension of business.	Value of Warnings.
Topeka, Kans.	$20,000	$130,000	.....	.....	.....
Terre Haute, Ind.	.....	50,000	.....	.....	$10,000
Indianapolis, Ind.	.....	30,000	.....	.....	.....
Little Rock, Ark.	14,940	761,000	$6,000	$257,300	1,000,000

The monetary loss to prospective crops as given above is probably overstated, since in the case of corn there is time to replant, thus confining the loss to the outlay for seed and the labor of replanting.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

TABLE 1.—*Flood stages in Atlantic and east Gulf drainages during May, 1918.*

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE.					
Tar:	*Feet.*			*Feet.*	
Rocky Mount, N. C.	9	.....	.....	8.9	17-18
Tarboro, N. C.	18	.....	.....	17.0	19
Greenville, N. C.	13	(†)	2	14.7	*28
Do.	.....	19	21	13.6	20
Neuse:					
Neuse, N. C.	14	15	16	14.6	15
Smithfield, N. C.	13	15	17	17.0	17
Cape Fear:					
Elizabethtown, N. C.	22	.....	.....	20.3	16
Waccamaw:					
Conway, S. C.	7	(†)	10	9.3	1-2
Black:					
Kingstree, S. C.	12	.....	.....	11.8	19-20
Santee:					
Rimini, S. C.	12	.....	.....	11.9	1
Ferguson, S. C.	12	(†)	4	13.6	*27
EAST GULF DRAINAGE.					
Tombigbee:					
Demopolis, Ala.	39	2	4	40.7	2
Chickasawhay:					
Enterprise, Miss.	21	1	2	22.4	1
Shubuta, Miss.	27	.....	.....	26.2	4
Pearl:					
Jackson, Miss.	20	1	12	22.9	4,8
Pearl River, La.	13	9	9	13.1	9

* April. † Continued from April.

TABLE 2.—*Flood stages in Mississippi River drainage during May, 1918.*

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
MISSISSIPPI PROPER.					
Mississippi:	*Feet.*			*Feet.*	
Warsaw, Ill.	17	.....	.....	16.7	28
Hannibal, Mo.	13	29	(**)	14.0	31
Louisiana, Mo.	12	31	(**)	12.1	31
Quincy, Ill.	14	.....	.....	13.5	31
Arkansas City, Ark.	42	.....	.....	38.2	26-28
Wisconsin:					
Knowlton, Wis.	12	28	29	13.4	29
Illinois:					
Fern, Ill.	14	.....	.....	13.2	26
Henry, Ill.	7	26	(**)	7.3	30-31
Beardstown, Ill.	12	9	24	12.4	20-21
Do.	.....	29	(**)	12.5	31
Grand:					
Chillicothe, Mo.	18	31	(**)	20.3	31
Gasconde:					
Arlington, Mo.	12	13	13	12.9	13

** Continued into June.

TABLE 2.—*Flood stages in Mississippi River drainage during May, 1918*—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
MISSISSIPPI RIVER.					
Meramec:	*Feet.*			*Feet.*	
Steelville, Mo.	12	13	13	12.5	13
Pacific, Mo.	11	(†)	1	20.4	*28
Do.		14	15	17.4	15
Valley Park, Mo.	14	14	16	21.6	15
Bourbeuse:					
Union, Mo.	10	14	14	11.6	14
Do.		25	25	10.3	25
St. Francis:					
Marked Tree, Ark.	17			16.6	23–24
					29–31
OHIO BASIN.					
Little Kanawha:					
Glenville, W. Va.	22	26	26	29.7	26
Tuscarawas:					
Coshocton, Ohio.	8			7.6	14
Norris Point, Ohio.	8			7.2	14
Walhonding:					
Walhonding, Ohio.	8	13	13	10.5	13
Scioto:					
Bellpoint, Ohio.	9	13	13	9.3	13
Circleville, Ohio.	7	14	15	12.2	14
Chillicothe, Ohio.	14	15	15	15.3	15
Olentangy:					
Delaware, Ohio.	9			8.9	13
Elk:					
Gassaway, W. Va.	24	25	25	24.8	25
Miami:					
Hamilton, Ohio.	12	13	13	12.4	13
Wabash:					
Mount Carmel, Ill.	15	13	23	19.6	18
White (East Fork):					
Decker, Ind.	18	14	22	21.5	18–19
Shoals, Ind.	20	13	14	20.4	14
Do.		16	19	23.4	17
White (West Fork):					
Elliston, Ind.	19	13	16	22.6	14
MISSOURI BASIN.					
Missouri:					
Brunswick, Mo.	10			9.5	31
Solomon:					
Beloit, Kans.	16	22	23	17.3	22
ARKANSAS BASIN.					
Arkansas:					
Dardanelle, Ark.	20	13	13	20.3	13
Petit Jean:					
Danville, Ark.	20	14	15	20.8	14
White:					
Batesville, Ark.	23	12	17	36.3	14
Calico Rock, Ark.	18	12	16	33.3	13
Newport, Ark.	26	14	25	32.3	15
Georgetown, Ark.	22	16	(**)	28.3	20
Clarendon, Ark.	30	25	(**)	30.4	27–29
Black:					
Black Rock, Ark.	14	8	(**)	25.7	14
Cache:					
Jelks, Ark.	9	21	(**)	9.8	24–25

† Continued from April.
* April.
** Continued into June.

TABLE 3.—*Flood stages in Great Lakes, West Gulf, and Pacific drainages, during May, 1918.*

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
GREAT LAKES.					
Sandusky:	*Feet.*			*Feet.*	
Upper Sandusky, Ohio.	13	15	15	13.0	15
Cass:					
Vassar, Mich.	14	27	28	14.7	27
WEST GULF.					
Sabine:					
Logansport, La.	25			22.5	11
Guadalupe:					
Victoria, Tex.	16	3	3	16.1	3
Do.		5	5	16.4	5
Rio Grande:					
Rio Grande City, Tex.	15	4	6	23.5	5
PACIFIC.					
Grand:					
State Bridge, Colo.	9			8.6	10, 16
Gunnison:					
Sapinero, Colo.	16			15.6	25
Gunnison, North Fork:					
Paonia, Colo.	8	5	9	8.3	7
Do.		15	20	8.3	16–18
Do.		22	22	8.0	22
Columbia:					
Marcus, Wash.	24			23.6	20–21
Vancouver, Wash.	15			14.6	20
Clearwater:					
Kamiah, Idaho.	14			13.3	5
Willamette:					
Portland, Oreg.	15			14.1	20–21

MEAN LAKE LEVELS DURING MAY, 1918.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., June 7, 1918.]

The following data are reported in the Notice to Mariners of the above date:

Data.	Lakes.*			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during May, 1918:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sealevel at New York	601.74	581.64	572.20	247.13
Above or below—				
Mean stage of April, 1918	+0.28	+0.24	−0.05	−0.04
Mean stage of May, 1917	−0.61	+0.52	−0.80	+0.62
Average stage for May, last 10 years	−0.19	+1.15	−0.59	+0.31
Highest recorded May stage	−1.31	−1.88	−2.22	−1.82
Lowest recorded May stage	+0.92	+2.08	+0.89	+2.17
Average relation of the May level to—				
April level	+0.3	+0.4	+0.4	+0.4
June level	−0.3	−0.3	−0.2	−0.2

* Lake St. Clair's level: In May, 575.11 feet.

SECTION V.—SEISMOLOGY.

SEISMOLOGICAL REPORTS FOR MAY, 1918.

W. J. Humphreys, Professor in Charge.

[Dated: Seismological Investigations, Weather Bureau, July 3, 1918.]

Table I.—*Noninstrumental earthquake reports, May, 1918.*

Day.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		ARIZONA.	° ′	° ′			M. s.			
1918. May 1	H. m. 4 32	Cibola	33 21	114 42	3	1	20	Rumbling	Gradual trembling E–W, rattling.	L. W. Bishop.
		Yuma	32 45	114 36	3	1	03	Rattling	Abrupt rocking and trembling.	S. Hackett.
		CALIFORNIA.								
1	4 32	Bonita	32 39	117 03	3	1	05	Rattling	Gradual rocking	R. M. Allen.
		Calexico	32 41	115 30	6	1	1 00	Faint	Rumbling. Abrupt trembling and twisting N–S. Plate-glass windows broken. Apparently central in Imperial Valley.	H. M. Rouse.
		El Centro	32 48	115 32		1	30		Doors and windows rattled	Associated Press.
		Julian	33 04	116 36	3-4	1	08	Faint	Rumbling. Abrupt trembling	J. H. L. Vogt.
		Point Loma	32 43	117 15	2	1	Few.	None	Vibration in all directions.	Fred J. Dick.
		San Diego	32 43	117 10	2	1	Few.	None	Vibration in all directions.	Fred J. Dick.
	5 10	Calexico	32 41	115 30	2	1	01	None	Rapid trembling	H. M. Rouse.
	7 10	Calexico	32 41	115 30	4	1	02	Loud	Rumbling. Rapid trembling N–S.	H. M. Rouse.
	11 12	Calexico	32 41	115 30	4	1	01	None	Rapid trembling	H. M. Rouse.
	14 50	Calexico	32 41	115 30	3	1	01	Faint	Rumbling. Gradual trembling NE–SW.	H. M. Rouse.
2	12 51	Calexico	32 41	115 30	3	1	03	Faint	Rumbling. Rapid bump, then a twist NE–SW. Four other quakes reported during night by others.	H. M. Rouse.
	17 12	Calexico	32 41	115 30	5	2	40	Faint	Rumbling. Gradual trembling N–S.	H. M. Rouse.
13	8 30	Lone Pine	36 37	118 02	4	3	Few.	None	Abrupt rocking	G. F. Marsh.
16	16 40	Hemet	33 44	116 58	3	1	01	Loud	Abrupt bumping NE	C. E. McManigal.
22	14 08	Calexico	32 41	115 30	3	1	01	Faint	Rumbling. Rapid bumping NE–SW.	H. M. Rouse.
24	9 35	Lone Pine	36 37	118 02		2	Few.	None	Bumping	G. F. Marsh.
25	17 37	Calexico	32 41	115 30	2	1	01	None	Abrupt bumping	H. M. Rouse.
28	12 30	Hemet	33 44	116 58	4	2	02	Yes	Abrupt bumping SE	C. E. McManigal.
		NEW MEXICO.								
28	11 30	Albuquerque	35 06	106 39	3	1	Few.	None	Slight trembling	Albuquerque Evening Herald.
		Cerillos	35 27	106 07	10				Many plastered ceilings and chimneys fell. People on street thrown off their feet. Heavy break in surface of earth at edge of town. No one badly injured.	Albuquerque Evening Herald.
		Espanola	36 00	106 05	3-5	1	02	Faint	Like distant thunder. Rapid rocking and trembling. People awakened.	Mrs. E. F. McBride.
		Estancia	34 49	106 04	2	1	1 00	None	Rapid twisting	J. L. Stubblefield.
		Lamy	35 29	105 53	7-8		12		Rapid twisting about six times. Frame house swayed back and forth and walls creaked in the corners of rooms.	T. W. Hanna.
		Las Vegas	35 35	105 14	2	1	Few.	None		Las Vegas Daily Optic.
		Montoya	35 06	104 04	2	2	10	None	Abrupt trembling	E. S. Micksch.
		Moriarty	34 59	106 03	5	1-3	05	Rumbling	Like distant thunder. Abrupt trembling.	H. M. Bigger.
		Pena Blanca	35 35	106 21	5-7	1				Samuel H. Sayce.
		Porvenir	35 43	105 25	2	1	Few.	None		R. E. Springfels.
		Santa Fe	35 41	105 57	4-7	1	03	Rumbling	Abrupt rocking SW–NE. Shook down plaster. Doors and windows rattled.	Charles E. Linney.
		Stanley	35 07	106 00	5-8	1		Rumbling	Abrupt bump and rocking E–W. Doors rattled, piano sounded, some adobe walls cracked.	Henry Winans.
		Valmora	35 47	104 59	2	1	Few.	None		Alice Brown.
		Waldo	35 28	106 10	5-8	1	Few.		Awakened people	Albuquerque Evening Herald.
		WASHINGTON.								
7	21 15	North Fork Sauk River.	48 06	121 22	4	1	05	Loud	Rumbling. Gradual trembling E–W.	C. M. Mackintosh.

TABLE 2.—*Instrumental seismological reports, May, 1918.*

(Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.)

[For significance of symbols see REVIEW for January, 1918, p. 34.]

Alaska. *Sitka. Magnetic Observatory.* U. S. Coast and Geodetic Survey. J. W. Green.

Lat., 57° 03′ 00″ N.; long., 135° 30′ 06″ W. Elevation, 15.2 meters.
Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants: E V 10, T_0 16; N V 10, T_0 15

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	*μ*	*μ*	*km.*	
1918. May 20	.....	eP_N	15 00 01	12	.....	.....	.....	E–W component out of order during entire month
		eL_N	15 12 45	34	.....	.....	.....	
		M_N	15 19 05	20	.....	60	.....	
		C	15 31 ..	.....	.....	.....	.....	
		F	16 08 ..	.....	.....	.....	.....	
23	.....	eP_N	12 05 03	.....	.....	.....	.....	
		S_N	12 10 06	.....	.....	.....	.....	
		eL_N	12 15 ..	28	.....	.....	.....	
		M_N	12 20 11	12	.....	280	.....	
		C	12 22 ..	9	.....	.....	.....	
		F	13 16 ..	.....	.....	.....	.....	

Arizona *Tucson. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat., 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.
Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants: E V 10, T_0 14; N V 10, T_0 18

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	*μ*	*μ*	*km.*	
1918. May 6	.....	e_N	4 59 10	3	.....	.....	.....	
		e_E	4 59 51	.....	.....	.....	.....	
		M_E	5 00 28	10	130	.....	.....	
		M_N	5 00 35	10	.....	120	.....	
		C	5 02 ..	.....	.....	.....	.....	
		F	5 12 ..	.....	.....	.....	.....	
20	.....	eP_E	14 46 ..	.....	.....	.....	.....	No motion on N–S.
		eS_E	14 57 ..	.....	.....	.....	.....	
		eL_E	15 11 ..	20	.....	.....	.....	
		M_E	15 19 05	16	50	.....	.....	
		C	15 22 ..	.....	.....	.....	.....	
		F	15 44 ..	.....	.....	.....	.....	
23	.....	eP_N	11 58 52	4	.....	.....	.....	Stylus off paper on N from 12h. 00m 50s to 12h 07m 12s and on E from 12h 00m 56s to 12h 05m 04s.
		eP_E	11 59 12	3	.....	.....	.....	
		eL_N	12 00 12	20	.....	.....	.....	
		eL_E	12 00 20	12	.....	.....	.....	
		M	.....	.....	6,000+	3,150+	.....	
		C	13 06 ..	.....	.....	.....	.....	
		F	13 20 ..	.....	.....	.....	.....	

California. *Berkeley. University of California.*

Lat., 37° 52′ 16″ N.; long., 122° 15′ 37″ W. Elevation, 85.4 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Mount Hamilton. Lick Observatory.*

Lat., 37° 20′ 24″ N.; long., 121° 38′ 34″ W. Elevation, 1,281.7 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Point Loma. Raja Yoga Academy.* F. J. Dick.

Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters.

Instrument: Two-component, C. D. West seismoscope.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	*μ*	*μ*	*km.*	
1918. May 1	II	.....	4 32 ..	.....	250	250	.....	Very light shock.
3	.....	.....	.....	.....	300	300	.....	Tremors during 24 hours preceding 15h 00m.
4	.....	.....	.....	.....	200	200	.....	
9	.....	.....	.....	.....	100	100	.....	
13	.....	.....	.....	.....	300	300	.....	
17	.....	.....	.....	.....	100	200	.....	

California. *Santa Clara. University of Santa Clara.* J. S. Ricard, S. J.

Lat., 37° 26′ 36″ N.; long., 121° 57′ 03″ W. Elevation, 27.43 meters.

(*See* record of the Seismographic Station, University of Santa Clara.)

Colorado. *Denver. Sacred Heart College.* Earthquake Station. A. W. Forstall, S. J.

Lat., 39° 40′ 35″ N.; long., 104° 56′ 54″ W. Elevation, 1,655 meters.

Instrument: Wiechert 80 kg.; astatic, horizontal pendulum.

Date.	Character.	Phase.	Time.	Period T.	Amplitude.	n	Distance.	Remarks.
			H. m. s.	*Sec.*	*μ*		*km.*	
1918. May 23	.....	P_E	? ? ?	.....	.....	.....	.....	
		P_N	13 01 ..	.....	.....	.....	.....	
		S_E	13 05 ?	.....	.....	.....	.....	
		S_N	13 05 ..	.....	.....	.....	.....	
		L_E	13 09 ..	12–15	*15,000	.....	.....	
		L_N	13 09 ..	9–12	.....	*18,000	.....	
		M_E	13 06 ..	12	*45,000	.....	.....	
		M_N	13 06 ..	10	.....	*46,000	.....	
		C_E	13 11 ..	.....	.....	.....	.....	
		C_N	13 14 ..	.....	.....	.....	.....	
		F	13 27 ..	.....	.....	.....	.....	
25	.....	L_N	11 30 ..	.....	.....	.....	.....	Visible activity. Stronger on N–S.
		F_N	13	.....	.....	.....	.....	
27	.....	L_N	12 10 ..	.....	.....	.....	.....	Sinusoidals of long period.
		F_N	13 30 ..	.....	.....	.....	.....	
28	.....	L	16 10 ..	.....	.....	.....	.....	Quake reported from Albuquerque, N. Mex. Wavelets visible on both components.
		F	18	.....	.....	.....	.....	
29	.....	L_N	13 35 ..	.....	.....	.....	.....	Distinct waves at intervals during day.
		F_N	14 20 ..	.....	.....	.....	.....	

* Trace amplitude.

TABLE 2.—*Instrumental seismological reports, May, 1918*—Continued.

District of Columbia. *Washington. U. S. Weather Bureau.*

Lat., 38° 54′ 12″ N.; long., 77° 03′ 03″ W. Elevation, 21 meters.

Instrument: Marvin (vertical pendulum, undamped. Mechanical registration).

Instrumental constants: $V = 110$, $T_0 = 6.4$

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 1	.....	eP.....	4 48 ?	.....	.....	.....	.....	Time correction uncertain.
		eS?.....	4 49 ?	.....	.....	.....	.....	
		L.....	4 50 ?	.....	.....	.....	.....	
		F.....	5 05 ..	.....	.....	.....	.....	
2	.....	e?.....	2 41 ..	.....	.....	.....	.....	Time correction uncertain.
		M.....	2 43 ?	.....	.....	.....	.....	
		F.....	2 50 ..	.....	.....	.....	.....	
6	.....	eP?.....	5 05 ?	.....	.....	.....	.....	Time correction uncertain.
		eS?.....	5 11 ?	.....	.....	.....	.....	
		L.....	5 16 ?	.....	.....	.....	.....	
		F.....	5 35 ..	.....	.....	.....	.....	
9	.....	eL?.....	9 54 ?	.....	.....	.....	.....	Time correction uncertain.
		F.....	10 00 ..	.....	.....	.....	.....	
11	.....	eP?.....	21 34 ?	.....	.....	.....	.....	Time correction uncertain.
		eS?.....	21 44 ?	.....	.....	.....	.....	
		eL.....	22 04 ..	16	.....	.....	.....	
		F.....	22 15 ..	.....	.....	.....	.....	
16	.....	e_E.....	21 42 17	.....	.....	.....	.....	
		L.....	21 46 02	10	.....	.....	.....	
		F.....	22	.....	.....	.....	.....	
20	.....	P.....	14 44 51	.....	.....	.....	.....	
		P_{rep}?..	14 49 31	.....	.....	.....	.....	
		S.....	14 51 55	.....	.....	.....	.....	
		L.....	14 58 35	20	.....	.....	.....	
		L.....	15 06 23	16	.....	.....	.....	
		L.....	15 13 38	10	.....	.....	.....	
		L.....	15 30 38	12	.....	.....	.....	
		F.....	16 30 ..	.....	.....	.....	.....	
20	.....	P.....	18 06 18	.....	.....	.....	.....	
		S.....	18 15 02	.....	.....	.....	.....	
		eL.....	18 30 33	28	.....	.....	.....	
		F.....	19 30 ..	.....	.....	.....	.....	
22	.....	eL.....	7 04 ..	.....	.....	.....	.....	
		F.....	7 15 ..	.....	.....	.....	.....	
23	.....	P.....	12 03 45	.....	.....	.....	.....	
		S.....	12 10 05	.....	.....	.....	.....	
		L.....	12 13 25	.....	.....	.....	.....	
		M.....	12 14 30	.....	*14,000	*31,000	.....	
		F.....	14 30 ..	.....	.....	.....	.....	
25	.....	P.....	19 40 34	.....	.....	.....	.....	
		S.....	19 49 38	.....	.....	.....	.....	
		eL.....	19 58 00	.....	.....	.....	.....	
		L.....	20 01 00	30	.....	.....	.....	
		F.....	20 25 ..	.....	.....	.....	.....	

* Trace amplitude.

District of Columbia. *Washington. Georgetown University.* F. L. Tondorf, S. J.

Lat., 38° 54′ 25″ N.; long., 77° 04′ 21″ W. Elevation, 42.4 meters. Subsoil: Decayed diorite.

Instruments: Wiechert 200 kg., astatic, horizontal pendulums, 80 kg., vertical.

Instrumental constants:

	V	T_0	ϵ
E	165	5.4	0
N	143	5.2	0
Z	*80*	*5.0*	*0*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 1	.....	e_N.....	4 48 31	.....	.....	.....	.....	
		e_E.....	4 48 33	.....	.....	.....	.....	
		L_E.....	4 52 12	11	.....	.....	.....	
		L_N.....	4 52 18	7	.....	.....	.....	
		F.....	4 56 ..	.....	.....	.....	.....	
2	.....	e?.....	2 33 28	.....	.....	.....	.....	e uncertain. Heavy microseisms.
		L_N.....	2 41 57	6	.....	.....	.....	
		L_E.....	2 42 46	6	.....	.....	.....	
		F.....	2 47 ..	.....	.....	.....	.....	
6	.....	e_E.....	5 12 26	.....	.....	.....	.....	Microseisms.
		e_N.....	5 12 27	.....	.....	.....	.....	
		L_N.....	5 13 12	11	.....	.....	.....	
		L_E.....	5 14 43	11	.....	.....	.....	
		F.....	5 27 ..	.....	.....	.....	.....	

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 16	.....	eP_N.....	21 38 23	.....	.....	.....	.....	Microseisms; P_E. does not show
		S?	21 43 21	.....	.....	.....	.....	No distinct main.
		eL_N.....	21 45 37	10	.....	.....	.....	
		L_E.....	21 46 15	11	.....	.....	.....	
		F.....	22 09 ..	.....	.....	.....	.....	
20	.....	iP_E.....	14 44 53	.....	.....	.....	.....	
		iP_N.....	14 44 54	.....	.....	.....	.....	
		iS.....	14 51 59	.....	.....	.....	.....	
		L.....	14 58 35	19	.....	.....	.....	
		M_E.....	14 59 40	.....	*1,500	.....	.....	
		M_N.....	14 59 51	.....	.....	*800	.....	
		F.....	16 20 ..	.....	.....	.....	.....	
20	.....	iP_N.....	18 06 02	.....	.....	.....	.....	No distinct main.
		eP_E.....	18 06 04	.....	.....	.....	.....	
		iS_E.....	18 15 02	.....	.....	.....	.....	
		eS_N.....	18 15 02	.....	.....	.....	.....	
		eL_N.....	18 26 16	.....	.....	.....	.....	
		eL_E.....	18 26 18	.....	.....	.....	.....	
		F.....	19 30 ..	.....	.....	.....	.....	
22	.....	e_E.....	6 55 08	.....	.....	.....	.....	
		i_E.....	6 56 00	.....	.....	.....	.....	
		e_N.....	6 56 47	.....	.....	.....	.....	
		L_E.....	7 04 27	11	.....	.....	.....	
		L_N.....	7 04 29	9	.....	.....	.....	
		F.....	7 22 ..	.....	.....	.....	.....	
23	.....	eP_N.....	12 03 57	.....	.....	.....	.....	From Bosch photographic seismograph. E–W light off. Lost on other seismographs while changing sheets.
		eS_N.....	12 09 40	.....	.....	.....	.....	
		eL_N.....	12 13 18	7.5	.....	.....	.....	
		M_{N1}..	12 14 16	.....	.....	*2,000	.....	
		M_{N2}..	12 17 40	.....	.....	*4,700	.....	
		M_{N3}..	12 19 07	.....	.....	*2,500	.....	
		M_{N4}..	12 19 40	.....	.....	*3,200	.....	
		F.....	14 ca....	.....	.....	.....	.....	
24	.....	.....	.....	.....	.....	.....	.....	A series of long waves appears to show on N–S. component from 16h 1m to 16h 8m.
25	.....	P.....	19 40 35	.....	.....	.....	.....	
		S_N.....	19 45 20	.....	.....	.....	.....	
		S_E.....	19 45 24	.....	.....	.....	.....	
		L.....	19 49 55	6	.....	.....	.....	
		F.....	20 30 ..	.....	.....	.....	.....	

* Trace amplitude.

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neumann.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Milne seismograph of the Seismological Committee of the British Association, E–W component.

Instrumental constant.... $T_0 = 31$

Date.	Character.	Phase.	Time.	Period T.	Amplitude. μ	Amplitude. μ	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 20	.....	P.....	14 56 24	.....	.....	.....	.....	Instrument out of adjustment during entire month of April and until May 20, and probably a portion of March also.
		S.....	15 02 00	.....	.....	.....	.....	
		L.....	15 06 00	.....	.....	.....	.....	
		M.....	15 12 42	30	*1,700	.....	.....	
		C.....	15 17 12	.....	.....	.....	.....	
		F.....	15 51 ..	.....	.....	.....	.....	
20	.....	e.....	18 13 00	.....	.....	.....	.....	Sheets changed 18h 37m 12s to 18h 43m 12s.
		L.....	18 19 12	31	.....	.....	.....	
		M.....	18 23 24	32	*1,500	.....	.....	
		C.....	18 27 ..	.....	.....	.....	.....	
		F.....	20 47 ..	.....	.....	.....	.....	
23	.....	e.....	12 05 00	.....	.....	.....	.....	
		L.....	12 15 00	24	.....	.....	.....	
		M.....	12 17 12	28	*1,500	.....	.....	
		C.....	12 22 ..	.....	.....	.....	.....	
		F.....	13 25 ..	.....	.....	.....	.....	
25	.....	eP.....	19 42 12	.....	.....	.....	.....	
		S.....	19 52 48	.....	.....	.....	.....	
		L.....	20 04 48	30	.....	.....	.....	
		M.....	20 06 36	42	*1,000	.....	.....	
		C.....	20 09 ..	.....	.....	.....	.....	
		F.....	20 27 ..	.....	.....	.....	.....	
31	.....	eP.....	9 01 12	.....	.....	.....	.....	
		eL.....	9 05 42	29	.....	.....	.....	
		M.....	9 08 36	29	*200	.....	.....	
		C.....	9 11 ..	.....	.....	.....	.....	
		F.....	9 25 ..	.....	.....	.....	.....	

* Trace of amplitude.

TABLE 2.—*Instrumental seismological reports, May, 1918*—Continued.

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.

Instrument: Wiechert.

Instrument constants. V T₀ ε
E 177 3.4 4:1
N 205 3.4 4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 1	.....	P_E?	4 38 45	.....	.....	.....	.....	P_N and S not discernible.
		eL_E	4 41 03	.....	.....	.....	.....	
		eL_N	4 41 08	.....	.....	.....	.....	
		M_E	4 41 34	2.5	0.6	.....	.....	
		M_N	4 41 37	4.5	1.5	.....	.....	
		F	4 51 ..	.....	.....	.....	.....	
6	.....	iP?	5 00 14	.....	.....	.....	.....	Probably building shock. S_N not discernible.
		eP	5 00 32	.....	.....	.....	.....	
		S_E	5 03 21	.....	.....	.....	.....	
		L_E	5 05 50	.....	.....	.....	.....	
		L_N	5 05 51	.....	.....	.....	.....	
		M	5 06 33	12–15	5.4	3.7	.....	
		F	5 26 ..	.....	.....	.....	.....	
20	.....	eP_E	16 46 21	.....	.....	.....	.....	N-S component tracing need'e out of bearings.
		S_E	16 55 57	.....	3.7	.....	.....	
		L_E	17 06 21	.....	.....	.....	.....	
		M_E	17 12 24	.....	6.2	.....	.....	
		F	17 47 ..	.....	.....	.....	.....	
23	.....	P	12 01 40	.....	.....	.....	.....	
		S_N	12 04 53	.....	.....	.....	.....	
		S_E?	12 04 59	.....	.....	.....	.....	
		L_N	12 07 01	.....	.....	.....	.....	
		L_E	12 07 03	.....	.....	.....	.....	
		M	12 ? ?	.....	72.6	63.9	.....	
		F_E	13 16 ..	.....	.....	.....	.....	
		F_N	13 25 ..	.....	.....	.....	.....	

Maryland. *Cheltenham. Magnetic Observatory.* U. S. Coast and Geodetic Survey. George Hartnell.

Lat., 38° 44′ 09″ N.; long., 76° 50′ 30″ W. Elevation, 71.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants. V T₀
E 10 15
N 10 15

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 20	.....	P	14 41 54	3	.....	.....	.....	
		S	14 51 55	10	380	330	.....	
		eL_N	14 58 40	20	.....	.....	.....	
		eL_E	14 58 50	20	.....	.....	.....	
		M_N	14 59 50	15	.....	110	.....	
		M_E	15 02 04	15	210	.....	.....	
		C	15 06 ..	.....	.....	.....	.....	
		F	15 54 ..	.....	.....	.....	.....	
20	.....	e_N	18 06 03	5	.....	.....	.....	
		e_E	18 06 21	5	.....	.....	.....	
		M_N	18 15 25	.....	.....	10	.....	
		M_E	18 15 39	.....	60	.....	.....	
		F	18 23 ..	.....	.....	.....	.....	
23	.....	e_N	12 09 14	.....	.....	.....	.....	
		eL	12 13 08	.....	.....	.....	.....	
		M_N	12 15 28	16	.....	900	.....	
		M_E	12 17 08	10	150	.....	.....	
		C	12 24 ..	.....	.....	.....	.....	
		F	13 09 ..	.....	.....	.....	.....	
25	.....	P	19 40 39	4	.....	.....	.....	
		eS_E	19 48 35	.....	.....	.....	.....	
		eL_E	19 58 ..	28	.....	.....	.....	
		M_E	19 02 20	24	20	10	.....	
		C	19 03 ..	.....	.....	.....	.....	
		F	19 17 ..	.....	.....	.....	.....	

Massachusetts. *Cambridge. Harvard University Seismographic Station.* J. B. Woodworth.

Lat., 42° 22′ 30″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants. V T₀ ε
E 80 23 0
N 50 25 4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 1	.....	e_E?	4 50 31	2	.....	.....	.....	
		S?	4 51 01	6	.....	.....	.....	
		L_N	4 51 20	12	.....	.....	.....	
		F	5 07 ca	.....	.....	.....	.....	
2	.....	L_N	2 43 19	.....	.....	.....	.....	
		L_E	2 43 27 2 44 38	9–8	.....	.....	.....	
		L_N	2 46 13	.....	.....	.....	.....	
		L_E	2 46 24	10	.....	.....	.....	
		L_N	2 47 10	.....	.....	.....	.....	
		F	2 50 19	.....	.....	.....	.....	
6	.....	O	5	.....	.....	.....	540?	Not heard from.
		eP_E	5 15 09	3	.....	.....	.....	
		L_E	5 16 08	12	.....	.....	.....	
		L	5 18 24	10	.....	.....	.....	
		F	5 26 30	.....	.....	.....	.....	
11	.....	e?	20 43 56	.....	.....	.....	.....	P? Record very faint.
		L_N	21 04 47	20	.....	.....	.....	
		L	21 06 38	16	.....	.....	.....	
		F	21 17 ca	.....	.....	.....	.....	
16	.....	e_N	21 45 34	.....	.....	.....	.....	P? or S?
		S_N	21 46 42	12, 15	.....	.....	.....	L?
		S_E	21 47 09	12	.....	.....	.....	L?
		L_N	21 49 20	10, 15	.....	.....	.....	
		L_E	21 49 28	8	.....	.....	.....	
		M_E	21 49 56	.....	.....	.....	.....	
		L	21 53 54	8, 12	.....	.....	.....	
		F_E	22 07 ca	.....	.....	.....	.....	
20	.....	O	17 35 53	.....	.....	.....	5,130	Alaska? Around 140° W., 60° N. N stylus left drum shortly after S set in; E shows almost continuous long waves to C.
		iP	14 41 19	.....	.....	.....	.....	
		P_E	14 44 41	.....	.....	.....	.....	
		S_N	14 51 08	.....	.....	.....	.....	
		S_E	14 51 22	.....	.....	.....	.....	
20	.....	O	17 55 13	.....	.....	.....	7,890	
		P_E	18 06 28	.....	.....	.....	.....	
		P_N	18 06 36	.....	.....	.....	.....	
		S_N	18 15 42	6	.....	.....	.....	
		S_E	18 15 46	.....	.....	.....	.....	
		eL_E	18 29 42	18	.....	.....	.....	
		L_N	18 31 20	32	.....	.....	.....	
		F?	20 ca ..	.....	.....	.....	.....	
20	.....	L_E	21 40 46 21 43 16	10	.....	.....	.....	Probably part of last record.
22	.....	O	6	.....	.....	.....	5,650?	5,000 to 7,000 kms. Difficult to diagnose.
		e_E?	6 50 08	4	.....	.....	.....	
		S_E?	6 56 42	6	.....	.....	.....	
		eL_E?	7 05 02 7 09 11	8 12	.....	.....	.....	
		F	7 24 39	.....	.....	.....	.....	
23	.....	O	11 57 22	.....	.....	.....	4,115	N component out of order.
		eP_E	12 04 48	.....	.....	.....	.....	
		S	12 10 41	.....	.....	.....	.....	
		eL_E	12 15 08	31	.....	.....	.....	
		L	12 16 30	.....	.....	.....	.....	T shortens and A increases.
		M^1	12 18 ca	10½	.....	.....	.....	
		M^2	12 20 ca	9½	.....	.....	.....	
		M^3	12 21 ca	.....	.....	.....	.....	
		M^4	12 22 ca	11½	.....	.....	.....	
		M^5	12 23 ca	.....	.....	.....	.....	
		M^6	12 25 ca	.....	.....	.....	.....	
		M^7	12 26 ca	.....	.....	.....	.....	
		C	12 53 ..	10, 13	.....	.....	.....	
		F?	13 15 ..	.....	.....	.....	.....	Records changed.

TABLE 2.—*Instrumental seismological reports, May, 1918*—Continued.

Missouri. *Saint Louis. St. Louis University.* Geophysical Observatory. J. B. Goesse, S. J.

Lat., 38° 38′ 15″ N.; long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.

Instrument: Wiechert 80 kg. astatic, horizontal pendulum.

Instrumental constants.. V 80, T_0 7, ε 5:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 7	.....	e?	5 01 12	.....	.....	.....	.....	Distance?
		L_E	5 07 24	2	*2,000	.....	.....	
		L_N	5 07 24	12	.....	*9,000	.....	
		F	5 17 00	.....	.....	.....	.....	
20	.....	iP	14 46 06	.....	.....	.....	6,600	
		S	14 54 06	.....	.....	.....	.....	
		L	15 03 12	.....	.....	.....	.....	
		M	15 08 48	18	*24,000	*15,000	.....	
		F	15 48 ..	.....	.....	.....	.....	
20	.....	iP_E	18 05 00	.....	.....	.....	4,000?	
		iP_N	18 06 18	.....	.....	.....	.....	
		S_E	18 ? ?	.....	.....	.....	.....	
		S_N	18 10 42	.....	.....	.....	.....	
		L_E	18 15 24	1	2,000	.....	.....	
		L_N	18 15 24	.....	.....	.....	.....	
		M_N	18 16 00	1	.....	*4,000	.....	
		F	18 50 00	.....	.....	.....	.....	
23	.....	iP	12 02 18	.....	.....	.....	2,300	
		S_N	12 06 06	.....	.....	.....	.....	
		S_E	12 06 12	.....	.....	.....	.....	
		L_E	12 07 06	9	*6,000	.....	.....	
		L_N	12 07 06	.....	.....	.....	.....	
		M	12 10 00	18	.....	*34,000	.....	
		F	13 12 ..	.....	.....	.....	.....	

New York. *Buffalo. Canisius College.* John A. Curtin, S. J.

Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.

Instrument: Wiechert 80 kg. horizontal.

Instrumental constants.. V 80, T_0 7, ε 5:1

(Report for May, 1918, not received.)

New York. *Fordham. Fordham University.* Daniel H. Sullivan, S. J.

Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.

Instrument: Wiechert, 80 kg.

Instrumental constants.. V 72, T_0 5.0, ε 0 (E), 72, 5.0, 0 (N)

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 20	.....	iP	15 40 12	.....	.....	.....	5,300	No decided M.
		iP_{ppl}	15 42 00	4	.....	.....	.....	
		iS_N	15 47 07	.....	.....	.....	.....	
		iS_E	15 47 10	.....	.....	.....	.....	
		L_N	15 50 49?	.....	.....	.....	.....	
		L_E	15 50 51?	.....	.....	.....	.....	
		F	17 00 ..	.....	.....	.....	.....	
20	.....	eP_N	19 01 43	.....	.....	.....	7,645	
		eP_E	19 01 49	.....	.....	.....	.....	
		iS_E	19 10 52	.....	.....	.....	.....	
		iS_N	19 10 58	.....	.....	.....	.....	
		L	19 ? ?	.....	.....	.....	.....	
		F	20 06 ..	.....	.....	.....	.....	

*Trace amplitude.

New York. *Ithaca. Cornell University.* Heinrich Ries.

Lat., 42° 26′ 58″ N.; long., 76° 29′ 09″ W. Elevation, 242.6 meters.

Instruments: Two Bosch-Omori, 25 kg., horizontal pendulums (mechanical registration).

Instrumental constants.. V, T_0, ε: E 13, 22, 4:1; N 14, 25, 4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 1	.....	e_N	4 48 52	3	.....	.....	.....	
		e_N	4 49 18	12	.....	.....	.....	
		F_N	4 59 30	.....	.....	.....	.....	
6	.....	e_N	5 08 20	6	.....	.....	.....	
		L_N	5 13 15	17	.....	.....	.....	
		L_E	5 13 23	19	.....	.....	.....	
		F_N	5 31 ..	.....	.....	.....	.....	
20	.....	P_E	14 44 53	3	.....	.....	.....	
		iS_E	14 52 14	13	*3,500	.....	.....	
		iS_N	14 52 15	15	.....	*3,400	.....	
		L_N	14 56 55	15	.....	.....	.....	
		L_E	14 57 25	22	.....	.....	.....	
		F_N	16 45 ..	.....	.....	.....	.....	
20	.....	P_N	18 06 22	3	.....	.....	.....	
		iS_E	18 15 36	6	*800	.....	.....	
		S_N	18 15 38	5	.....	.....	.....	
		i_E	18 16 12	6	*900	.....	.....	
		i_N	18 16 12	6	.....	*700	.....	
		eL_E	18 27 18	18	.....	.....	.....	
		L_N	19 04 28	35	.....	.....	.....	
		L_E	19 05 36	28	.....	.....	.....	
		F_E	19 30 ..	.....	.....	.....	.....	
22	.....	e_E	6 54 52	5	.....	.....	.....	
		e_N	6 56 44	6	.....	.....	.....	
		e_E	6 58 55	6	.....	.....	.....	
		eL_N	7 04 23	11	.....	.....	.....	
		F_N	7 24 ..	.....	.....	.....	.....	
23	.....	e_E	12 03 56	4	.....	.....	.....	
		e_N	12 09 05	4	.....	.....	.....	
		e_E	12 09 08	8	.....	.....	.....	
		eL_N	12 11 42	12	.....	.....	.....	
		M_N	12 15 00	10	.....	*8,000	.....	
		M_N	12 15 55	9	.....	*8,000	.....	
		M_N	12 16 11	11	.....	*8,000	.....	
		M_E	12 17 28	11	*4,000	.....	.....	
		F_N	14 21 ..	.....	.....	.....	.....	
25	.....	eP_N	19 40 38	4	.....	.....	.....	
		eP_E	19 40 43	4	.....	.....	.....	
		eS_N	19 50 14	9	.....	.....	.....	
		eS_E	19 50 19	8	.....	.....	.....	
		L_E	20 00 47	46	.....	.....	.....	
		F_E	20 34 ..	.....	.....	.....	.....	

Panama Canal. *Balboa Heights.* Governor, Panama Canal.

Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters.

Instruments: Two Bosch-Omori, 100 kg.

Instrumental constants.... V 35, T_0 20

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. May 20	.....	P	14 43 48	.....	.....	.....	3,220?	Direction uncertain.
		L_N	14 53 52?	20	.....	.....	.....	
		L_E	14 54 04?	20	.....	.....	.....	
		M_{Ne}	14 54 04	.....	*2,500	*4,500	.....	
		M_E	14 54 12	.....	.....	.....	.....	
		F_N	15 29 ..	.....	.....	.....	.....	
		F_E	15 30 ..	.....	.....	.....	.....	
20	.....	P_E	18 02 04	.....	.....	.....	3,220?	Direction uncertain.
		P_N	18 02 10	.....	.....	.....	.....	
		L_E	18 12 04?	20	.....	.....	.....	
		L_N	18 12 08?	20	.....	.....	.....	
		M	18 12 12	.....	*1,500	*1,000	.....	
		F	18 26 ..	.....	.....	.....	.....	
25	.....	P_E	19 36 33	.....	.....	.....	2,010?	Direction uncertain.
		P_N	19 36 35	.....	.....	.....	.....	
		L_N	19 42 46	20	.....	.....	.....	
		M_N	19 43 06	.....	.....	*2,000	.....	
		L_E	19 45 45	20	.....	.....	.....	
		M_E	19 46 07	.....	*1,500	.....	.....	
		F_E	20 22 ..	.....	.....	.....	.....	
		F_N	20 26 ..	.....	.....	.....	.....	

* Trace amplitude.

TABLE 2.—*Instrumental seismological reports, May, 1918*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Porto Rico. *Vieques. Magnetic Observatory.* U. S. Coast and Geodetic Survey. W. M. Hill.								
Lat., 18° 09′ N.; long., 65° 27′ W. Elevation, 19.8 meters.								
Instruments: Two Bosch-Omori.								
Instrumental constants..				V	T_0			
				E	10	18		
				N	10	20		
1918.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
May 20	.....	eP_E	14 42 30	3	.....	.....	.....	
		eP_N	14 42 31	3	.....	.....	.....	
		eS_E	14 47 30	8	.....	.....	.....	
		eS_N	14 47 38	6	.....	.....	.....	
		eL_E	14 49 16	22	.....	.....	.....	
		eL_N	14 49 37	26	.....	.....	.....	
		M_N	14 49 57	26	.....	180	.....	
		M_E	14 52 26	20	330	.....	.....	
		C_E	14 55 ..	.....	.....	.....	.....	
		C_N	14 57 ..	.....	.....	.....	.....	
		F	15 33 ..	.....	.....	.....	.....	
20	.....	e_N	18 05 55	.....	.....	.....	.....	No distinct phases.
		eL_E	18 13 30	16	.....	.....	.....	
		eL_N	18 14 ..	.....	.....	.....	.....	
		M_E	18 14 42	.....	20	10	.....	
		F	18 35 ..	.....	.....	.....	.....	
25	.....	e_N	19 38 54	.....	.....	.....	.....	Do.
		eL_E	19 46 21	.....	.....	.....	.....	
		eL_N	19 46 25	.....	.....	.....	.....	
		F	20 00 ..	.....	.....	.....	.....	
Vermont. *Northfield. U. S. Weather Bureau.* Wm. A. Shaw.								
Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters.								
Instruments: Two Bosch-Omori, mechanical registration.								
Instrumental constants..				V	T_0			
				E	10	15		
				N	10	16		
1918.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
May 6	.....	e	5 14 40	.....	.....	.....	.....	
		L	5 15 45	12	.....	.....	.....	
		F	5 30 ..	.....	.....	.....	.....	
11	.....	e	21 57 ..	.....	.....	.....	.....	
		F	22 10 ..	.....	.....	.....	.....	
16	.....	e	21 49 ..	.....	.....	.....	.....	
		F	22 00 ..	.....	.....	.....	.....	
20	.....	e	14 44 50	.....	.....	.....	.....	
		S	14 52 00	.....	.....	.....	.....	
		L	14 57 05	18	.....	.....	.....	
		L	15 00 00	20	.....	.....	.....	
		F	16 00 ..	.....	.....	.....	.....	
20	.....	e	18 06 37	.....	.....	.....	.....	
		S	18 16 00	.....	.....	.....	.....	
		F	18 30 ..	.....	.....	.....	.....	
23	.....	e	12 04 50	.....	.....	.....	.....	
		eL	12 12 30	12	.....	.....	.....	
		F	13 30 ..	.....	.....	.....	.....	
25	.....	e	19 50 48	.....	.....	.....	.....	
		eL	19 57 50	.....	.....	.....	.....	
		L	20 04 00	20	.....	.....	.....	
		F	20 20 ..	.....	.....	.....	.....	
Canada. *Ottawa. Dominion Astronomical Observatory.* Earthquake Station. Otto Klotz.								
Lat., 45° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevation, 83 meters.								
Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoyer 80 kg. vertical seismograph.								
Instrumental constants..				V	T_0			
				120	26			
1918.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
May 1	.....	*0?*	*4 48 10*	.....	.....	.....	440?	
		eP?	4 49 11	.....	.....	.....	.....	
		eS?	4 50 00	.....	.....	.....	.....	
		L	4 50 30†	8	.....	.....	.....	
		L	4 55 ..	6	.....	.....	.....	
		F	5 05 ..	.....	.....	.....	.....	
2	.....	e?	2 38 20	2	.....	.....	.....	Heavy wind tremors all day interfere with the reading in both of these earthquakes. They may not be seismic.
		e?	2 40 ..	8	.....	.....	.....	
		F	2 48 ..	.....	.....	.....	.....	
2	.....	eL?	4 46 ..	12	.....	.....	.....	
		F	4 50 ..	.....	.....	.....	.....	

† Original time given in tenths of a minute.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Canada. *Ottawa. Dominion Astronomical Observatory*—Contd.								
1918.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
May 6	.....	*0?*	*5 00 56*	.....	.....	.....	2,610?	
		eP?	5 06 14	.....	.....	.....	.....	
		eS?	5 10 28	8	.....	.....	.....	
		eL	5 13 ..	.....	.....	.....	.....	
		M	5 16 ..	8	.....	.....	.....	
		L	5 19 ..	8	.....	.....	.....	
		L	5 25 ..	7	.....	.....	.....	
		L	5 30 ..	7	.....	.....	.....	
		L	5 43 ..	10	.....	.....	.....	
		F	5 50 ..	.....	.....	.....	.....	
9	.....	e	9 52 12	1	.....	.....	.....	
		eL	9 52 30†	12	.....	.....	.....	
		L	9 54 30†	9	.....	.....	.....	
		F	10	.....	.....	.....	.....	
11	.....	*0*	*21 23 16*	.....	.....	.....	8,980	
		eP	21 35 28	.....	.....	.....	.....	
		eS	21 45 37	.....	.....	.....	.....	
		eL	22 03 ..	30	.....	.....	.....	
		L	22 10 ..	15	.....	.....	.....	
		L	22 15 ..	15	.....	.....	.....	
		F	22 35 ..	.....	.....	.....	.....	
16	.....	*0?*	*21 27 44*	.....	.....	.....	2,930?	
		eP?	21 33 34	.....	.....	.....	.....	
		eS?	21 38 12	.....	.....	.....	.....	
		eL?	21 40 40	.....	.....	.....	.....	
		L	21 47 ..	9	.....	.....	.....	
		L	21 50 ..	7	.....	.....	.....	
		L	21 54 ..	7	.....	.....	.....	
		L	22 00 ..	7	.....	.....	.....	
		F	22 10 ..	.....	.....	.....	.....	
20	.....	*0*	*14 35 55*	.....	.....	.....	5,740	The L waves arrive 3 minutes too early giving a velocity of 260 km/min. instead of the usual 228 km. The same is true of the Saskatoon record read here.
		iP	14 45 10	.....	.....	.....	.....	
		iS	14 52 32	.....	.....	.....	.....	
		eL	14 58 ..	22	.....	.....	.....	
		L	15 05 ..	20	.....	.....	.....	
		L	15 08 ..	16	.....	.....	.....	
		L	15 15 ..	16	.....	.....	.....	
		L	15 30 ..	9	.....	.....	.....	
		L	15 45 ..	17	.....	.....	.....	
		L	16 05 ..	10	.....	.....	.....	
		F	17	.....	.....	.....	.....	
20	.....	*O*	*17 55 15*	.....	.....	.....	8,120	
		P	18 06 42	.....	.....	.....	.....	
		P_{rep}^1	18 09 46	.....	.....	.....	.....	
		P_{rep}^2	18 11 30†	.....	.....	.....	.....	
		S	18 16 08	.....	.....	.....	.....	
		S_{rep}^1	18 21 15	.....	.....	.....	.....	
		eL	18 30 ..	.....	.....	.....	.....	
		L	18 35 ..	35	.....	.....	.....	
		L	18 40 ..	21	.....	.....	.....	
		L	18 45 ..	17	.....	.....	.....	
		eL	19 02 ..	40	.....	.....	.....	Unusual increase in period of the L waves again.
		L	19 10 ..	21	.....	.....	.....	
		L	19 15 ..	18	.....	.....	.....	
		F	19 35 ..	.....	.....	.....	.....	
22	.....	*O*	*6 41 15*	.....	.....	.....	5,300	
		eP	6 50 02	.....	.....	.....	.....	
		iS	6 57 00	.....	.....	.....	.....	
		eL	7 04 48†	.....	.....	.....	.....	
		L	7 12 ..	8	.....	.....	.....	
		L	7 40 ..	8	.....	.....	.....	
		F	8	.....	.....	.....	.....	
23	.....	*O*	*11 57 13*	.....	.....	.....	3,660	
		eP	12 04 06	.....	.....	.....	.....	
		eS	12 09 33	.....	.....	.....	.....	
		eL	12 13 ..	.....	.....	.....	.....	
		L	12 32 ..	.....	.....	.....	.....	
		L	12 45 ..	.....	.....	.....	.....	
		F	13 ? ?	.....	.....	.....	.....	F lost in changing sheets.
25	.....	*O*	*19 29 26*	.....	.....	.....	8,520	
		iP	19 41 14	.....	.....	.....	.....	
		S	19 51 00	.....	.....	.....	.....	
		i	19 55 48†	.....	.....	.....	.....	
		eL	20 06 ..	40	.....	.....	.....	
		L	20 13 ..	16	.....	.....	.....	
		L	20 28 ..	8	.....	.....	.....	
		F	20 50 ..	.....	.....	.....	.....	
26	.....	e	10 10 32	.....	.....	.....	.....	May not be seismic.
		F	10 13 20	.....	.....	.....	.....	
30	.....	e	22 37 ..	7	.....	.....	.....	
		F	22 47 ..	.....	.....	.....	.....	

TABLE 2.—*Instrumental seismological reports, May, 1918*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Canada. *Toronto. Dominion Meteorological Service.*								
Lat. 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.								
Instrument: Milne horizontal pendulum, North. In the meridian.								
Instrumental constant.. T_0 18. Pillar deviation: 1 mm. swing of boom=0.50″.								
1918.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
May 1...	.....	L.....	4 45 36†	.....	.....	.....	.....	
	.....	L.....	4 49 36?	.....	*50	.....	.....	Air currents going on.
2...	.....	.....	.....	.....	.....	.....	.....	Microseisms going on during morning that would mask any small quake.
4...	.....	.....	.....	.....	.....	.....	.....	
6...	.....	iL.....	5 12 24	.....	.....	.....	.....	Microseisms at intervals.
	.....	M.....	5 12 54	.....	*300	.....	.....	
	.....	F.....	5 22 12	.....	.....	.....	.....	
11...	.....	L.....	22 03 30	.....	*50	.....	.....	
	.....	F.....	22 15 54	.....	.....	.....	.....	
16...	.....	eL.....	21 47 12	.....	.....	.....	.....	
	.....	M.....	21 50 12	.....	*200	.....	.....	
	.....	F.....	22 06 18	.....	.....	.....	.....	
20...	.....	L.....	14 23 42	.....	*100	.....	.....	Thickening.
	.....	F.....	14 26 42	.....	.....	.....	.....	
20...	.....	eP.....	14 45 12	.....	.....	.....	6,340	La Serena, Chili. A clear record.
		iP.....	14 52 24	.....	.....	.....	.....	
		iS.....	14 53 06	.....	.....	.....	.....	
		eL.....	14 58 24	.....	*4,300	.....	.....	
		L.....	15 01 06	Fast.	.....	.....	.....	
		L.....	15 02 18	Slow.	.....	.....	.....	
		M.....	15 05 42	18–24	*7,300	.....	.....	
		iL.....	15 08 30	18	.....	.....	.....	
		iL.....	15 12 30	.....	.....	.....	.....	
20...	.....	S or L.	18 15 48	.....	.....	.....	.....	May be a dual quake.
		M.....	18 16 30	.....	*1,300	.....	.....	
		eL.....	19 06 24	.....	.....	.....	.....	
		eL.....	19 11 12	.....	.....	.....	.....	
		M.....	19 20 36	.....	*800	.....	.....	
		eL.....	20 15 42	.....	.....	.....	.....	
		M.....	20 22 00	.....	*300	.....	.....	
		F.....	20 52 36	.....	.....	.....	.....	
22...	.....	L.....	6 55 24	.....	*50	.....	.....	
		F.....	7 51 36	.....	.....	.....	.....	
23...	.....	S.....	12 09 36	.....	.....	.....	.....	P not recorded. Alaska.
		iS.....	12 13 36	.....	.....	.....	.....	
		iL.....	12 14 30	.....	.....	.....	.....	
		M.....	12 17 00	.....	*8,000	.....	.....	
		L.....	14 12 09	.....	.....	.....	.....	
		F.....	15 19 54?	.....	.....	.....	.....	
25...	.....	L.....	19 51 30	.....	.....	.....	.....	
		eL.....	20 00 48	.....	.....	.....	.....	
		M.....	20 02 48	.....	*300	.....	.....	
		F.....	20 38 42	.....	.....	.....	.....	

* Trace amplitude.
† Original time of all readings given in tenths of seconds.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Canada. *Victoria, B. C. Dominion Meteorological Service.*								
Lat., 48° 24′ N.; long., 123°.19′ W. Elevation, 67.7 meters. Subsoil: Rock.								
Instruments: Wiechert, vertical. Milne horizontal pendulum, North; in the meridian.								
Instrumental constant..T_0 18. Pillar deviation: 1 mm. swing of boom=0.54″.								
1918.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
May 1...	.....	P or L	4 40 41	.....	.....	.....	.....	
	.....	M.....	4 44 37	.....	*300	.....	.....	
	.....	F.....	4 48 33	.....	.....	.....	.....	
4...	.....	M?.....	7 13 10?	.....	*50	.....	.....	May not be a quake.
4–11...	.....	.....	.....	.....	.....	.....	.....	Sheets reversed when put on. Record too faint to detect any small quake.
16...	.....	P.....	21 41 49?	.....	.....	.....	1,100?	
	.....	L.....	21 43 47	.....	.....	.....	.....	
	.....	M.....	21 45 16	.....	*500	.....	.....	
	.....	F.....	21 53 42	.....	.....	.....	.....	
20...	.....	P.....	14 49 05	.....	.....	.....	8,870	La Serena, Chili.
		S.....	14 59 09	.....	.....	.....	.....	
		L.....	15 16 12	.....	.....	.....	.....	
		M.....	15 25 17	.....	*9,000	.....	.....	
		F.....	17 27 46	.....	.....	.....	.....	
			VERTICAL.			A_Z	.....	
		P.....	*14 48 54*	*2–3*	.....	.....	*10,180*	*La Serena, Chili.*
		S.....	*15 00 00*	*9*	.....	.....	.....	
		L.....	*15 16 30*	*30*	.....	.....	.....	
		M.....	*15 22 30*	*24*	.....	*7*	.....	
20...	.....	P.....	18 08 22	.....	.....	.....	9,160	May also be from Chili.
		S.....	18 18 41	.....	.....	.....	.....	
		L.....	18 34 55	.....	.....	.....	.....	
		M.....	18 47 22	.....	*1,000	.....	.....	
		F.....	20 44 15	.....	.....	.....	.....	
			VERTICAL.			A_Z	.....	
		P.....	*18 07 30*	*2–3*	.....	.....	.....	
		S.....	*18 20 12*	*6*	.....	.....	.....	
		L.....	*18 ? ?*	.....	.....	.....	.....	
		M.....	*18 41 30*	*30–36*	.....	*3*	.....	
		F.....	*? ? ?*	.....	.....	.....	.....	
22...	.....	L.....	6 52 44	.....	.....	.....	.....	
		M.....	6 55 41	.....	*300	.....	.....	
		F.....	6 59 39	.....	.....	.....	.....	
23...	.....	P.....	12 02 31	.....	.....	.....	2,930	S waves of fairly large amplitude. Alaska.
		S.....	12 07 09	.....	.....	.....	.....	
		L.....	12 10 08	.....	.....	.....	.....	
		M.....	12 13 36	.....	*18,500	.....	.....	
		F.....	13 54 45	.....	.....	.....	.....	
			VERTICAL.			A_Z	.....	
		P.....	*12 02 50*	*3*	.....	.....	*2,780*	*Alaska.*
		S.....	*12 07 17*	*9*	.....	.....	.....	
		L.....	*12 10 59*	*14*	.....	.....	.....	
		M.....	*12 12 30*	*15*	.....	29	.....	
		F.....	*? ? ?*	.....	.....	.....	.....	
25...	.....	P?.....	19 40 25	.....	.....	.....	10,040	
		S?.....	19 51 25	.....	.....	.....	.....	
		L.....	20 04 55	.....	.....	.....	.....	
		M.....	20 16 25	.....	*500	.....	.....	
		F.....	20 52 25	.....	.....	.....	.....	

* Trace amplitude.

TABLE 3.—*Late seismological reports (instrumental).*

Massachusetts. *Cambridge. Harvard University Seismographic Station,* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 07′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants. V T₀ ε
E 80 23 0
N 50 25 4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. Feb. 1	.....	$Oi M_E$	*8 57 44*	.....	.....	.....	0.1	Frost crack at station.
		C	8 57 45	.....	.....	.....	.....	
		F	8 57 50	.....	.....	.....	.....	
3	.....	eL_E	15 01 25	20	.....	.....	.....	Very faint, N microseisms running.
		L	15 13 27	15	.....	.....	.....	
		F	15 43 ..	.....	.....	.....	.....	
12	.....	L_E	10 03 48	28	.....	.....	.....	
		F	10 45 ca	.....	.....	.....	.....	
13	.....	e_N	3 43 ca	.....	.....	.....	.....	Preceded for several hours by long period pulsations not clearly seismic.
		L_N	3 55 04	24	.....	.....	.....	
			3 58 26	.....	.....	.....	.....	
		L_N	3 59 25	20	.....	.....	.....	
		F	? ? ?	.....	.....	.....	.....	
13	.....	*O*?	*6 08 ca*	.....	.....	.....	12,400	Δ and *O* from eL–S. Displacement of stylus. Both components undamped; but M amplitudes very much larger on N than on E.
		e_N?	6 20 13	.....	.....	.....	.....	
		e_E	6 28 04	.....	.....	.....	.....	
		S_N?	6 35 45	.....	.....	.....	.....	
		e	6 37 51	10	.....	.....	.....	
		S_{rept}?	6 44 07	32	.....	.....	.....	
			6 44 49	40	.....	.....	.....	
		S_{rept}	6 52 02	20-24	.....	.....	.....	
		eL_N	7 01 34	56	.....	.....	.....	
			.....	50	.....	.....	.....	
			.....	48	.....	.....	.....	
		eL_E	7 01 50	30	.....	.....	.....	
		L_N	7 02 10	40	.....	.....	.....	
		M_N1	7 14 ..	24	.....	.....	.....	
		2	7 15 40	.....	.....	.....	.....	
		3	7 17 15	.....	.....	.....	.....	
		4	7 19 15	.....	.....	.....	.....	
		5	7 22 ..	.....	.....	.....	.....	
		C_N	7 28 ca	.....	.....	.....	.....	
		F	8 23 ..	.....	.....	.....	.....	
19	.....	L?	17 23 ca	.....	*30,000?	.....	.....	Record too uncertain for closer readings.
		L?	18 02 ..	.....	*15,000	.....	.....	
20	.....	e	*5 52 24*	.....	.....	.....	.....	Variable short periods.
		F	5 53 25	.....	.....	.....	.....	
20	.....	e	6 50 01	.....	.....	.....	.....	Variable short periods.
		F	6 51 03	.....	.....	.....	.....	
24	.....	e_E	23 12 36	.....	.....	.....	.....	Heavy microseisms.
		L	23 14 07	26	.....	.....	.....	
		L	23 14 33	20	.....	.....	.....	
			.....	15	.....	.....	.....	
		F	23 24 ca	.....	.....	.....	.....	
1918. Mar. 16	.....	*O*	*13 40 54*	.....	.....	.....	3,350	Heavy microseisms.
		eP_E	13 47 14	2	.....	.....	.....	
		S	13 52 21	6	.....	.....	.....	
		eL_E	13 55 15	12	.....	.....	.....	
		L	14 22 34	15	.....	.....	.....	
			14 23 39		.....	.....	.....	
		F	14 26 30?	.....	.....	.....	.....	
19	.....	L_E	6 57 25	.....	.....	.....	.....	
		L	6 59 22	20	.....	.....	.....	
		L	7 13 44	15	.....	.....	.....	
		F	7 46 ..	.....	.....	.....	.....	
20	.....							Records during morning hours too much entangled to be deciphered.
21	.....							
1918. Apr. 10	.....	*O*	*1 10 45*	.....	.....	.....	350	Not heard from.
		P_E	1 11 35	.....	.....	.....	.....	
		S	1 12 18	.....	.....	.....	.....	
		M	1 12 22	.....	.....	.....	.....	
		C	1 12 47	.....	.....	.....	.....	
		F	1 14 03	.....	.....	.....	.....	
10	.....	*O*	*2 ? ?*	.....	.....	.....	3,710?	i notable, may be S.
		i_E	2 26 22	.....	.....	.....	.....	
		L	2 28 55	8	.....	.....	.....	
		M?	2 30 12	.....	.....	.....	.....	
		F	2 50 30	.....	.....	.....	.....	
13	.....	L_E	2 15 46	20	.....	.....	.....	Microseisms.
		F?	2 22 10	.....	.....	.....	.....	

* Trace amplitude.

Massachusetts. *Cambridge. Harvard University Seismographic Station*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. Apr. 15	.....	*O*	*8 27 41*	.....	.....	.....	5,740	No M.
		eP_E	8 36 56	2	.....	.....	.....	
		S	8 44 18	6	.....	.....	.....	
		L	8 50 06	.....	.....	.....	.....	
		F?	9 20 ca	.....	.....	.....	.....	
17	.....	L_E	3 10 56	20	.....	.....	.....	
			.....	15	.....	.....	.....	
			3 20 55	.....	.....	.....	.....	
		L_E	4 00 54	8-9	.....	.....	.....	
			4 02 56	.....	.....	.....	.....	
		e	4 06 01	.....	.....	.....	.....	
		F	4 06 36	.....	.....	.....	.....	
17	.....	*O*	*6 50 07*	.....	.....	.....	3,220	Press reports shock in Martinique about this time. P masked by microseisms. No N record.
		e	6 58 20	.....	.....	.....	.....	
		S	7 01 23	6	.....	.....	.....	
		eL_E	7 04 14	9	.....	.....	.....	
		F	7 28 ca	.....	.....	.....	.....	
21	.....	*O*	*22 32 24*	.....	.....	.....	4,040	Severe shock reported at San Jacinto and Hemet, Cal.
		P_E	22 39 45	.....	.....	.....	.....	
		S	22 45 34	.....	.....	.....	.....	
		eL_E	22 49 08	.....	.....	.....	.....	
		L	22 49 52	9	.....	.....	.....	
		L	22 51 34	.....	.....	.....	.....	A increases and T diminishes. Stylus left drum for 1m, 11s. Trace of A, 65mm.
		M_E	22 55 00	.....	.....	.....	.....	
22	.....	F	0 48 27	.....	.....	.....	.....	
27	.....	L_E?	20 35 01	5-8	.....	.....	.....	Nonsinusoidal.
		L	20 36 46	6	.....	.....	.....	
		M	20 37 33	11	.....	.....	.....	
		F	20 37 48	.....	.....	.....	.....	
27	.....	*O*?	*14 43 43*	.....	.....	.....	3,950?	
		e?	14 52 ca	.....	.....	.....	.....	
		S_E	14 56 42	6	.....	.....	.....	
		eL_E	15 01 03	28	.....	.....	.....	
		L	15 04 08	15	.....	.....	.....	
		F	15 25 ..	.....	.....	.....	.....	

New York. *Ithaca. Cornell University.* Heinrich Ries.

Lat., 42° 26′ 58″ N.; long. 76° 29′ 09″ W. Elevation, 242 meters.

Instruments: Two Bosch-Omori, 25 kg., horizontal pendulums (mechanical registration).

Instrumental constants. V T₀ ε
E 13 22 4:1
N 14 25 4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1918. Mar. 19	.....	eL_N	6 57 50	20	.....	.....	.....	Omitted from March report.
		F_E	7 38 ..	.....	.....	.....	.....	
1918. Apr. 19	.....	eP	1 10 58	1	.....	.....	.....	
		S_E	1 11 09	4	*300	.....	.....	
		S_N	1 11 11	3	.....	.....	.....	
		F_N	1 12 05	.....	.....	.....	.....	
		F_E	1 14 ..	.....	.....	.....	.....	
19	.....	P_E	2 25 33	2	.....	.....	.....	
		P_N	2 25 34	2	.....	.....	.....	
		eS_E	2 26 00	4	.....	.....	.....	
		eS_N	2 26 02	3	.....	.....	.....	
		F_N	2 28 ..	.....	.....	.....	.....	
15	.....	P_E	8 36 14	4	.....	.....	.....	
		P_N	8 36 25	4	.....	.....	.....	
		S_E	8 43 22	4	.....	.....	.....	
		S_N	8 43 23	7	.....	.....	.....	
		eL_N	8 52 ..	8	.....	.....	.....	
		F_N	9 12 ..	.....	.....	.....	.....	
17	.....	eL_N	3 13 ..	12	.....	.....	.....	
		F_N	3 29 ..	.....	.....	.....	.....	
17	.....	L_N	7 01 19	28	.....	.....	.....	
		L_N	7 04 40	10	.....	.....	.....	
		F_N	7 19 ..	.....	.....	.....	.....	
21	.....	P_E	22 38 57	4	.....	.....	.....	
		S_E	22 44 24	5	.....	.....	.....	
		S_N	22 44 25	6	.....	.....	.....	
		L_N	22 47 16	15	.....	.....	.....	
		M_N	22 50 10	16	.....	*20,000	.....	
		M_E	22 52 25	9	*8,000	.....	.....	
22	.....	F_N	00 30 ..	.....	.....	.....	.....	
27	.....	eL_N	15 02 23	21	.....	.....	.....	
		F_N	15 15 ..	.....	.....	.....	.....	

* Trace amplitude.

SEISMOLOGICAL DISPATCHES.[1]

El Centro, Cal., April 30, 1918.
An earthquake shock, lasting 30 seconds, was felt here at 9:35 o'clock to-night. Doors and windows rattled. Damage slight. (Assoc. Pr.)

Phoenix, Ariz., April 30, 1918.
Yuma, Ariz, felt an earthquake shock which lasted for a few seconds, at 9:33 o'clock to-night. No damage. (Assoc. Pr.)

Calexico, Cal., April 30, 1918.
An earthquake shock was felt here shortly after 9 o'clock to-night. Plate glass windows were broken. No further damage was done. (Assoc. Pr.)

Los Angeles, Cal., May 1, 1918.
A single earth tremor felt throughout the Imperial Valley in southern California and western Arizona at 9:32 last night caused only slight damage at various points which had reported early to-day. The shock appeared to have been most severe at El Centro. Reports from San Jacinto and Hemet indicate that the shocks were not felt there. At Calexico, plate glass windows were broken. (Assoc. Pr.)

Santiago, Chile, May 21, 1918.
The earthquake yesterday at La Serena, capital of the Province of Coquimbo, damaged a large number of buildings. Fire started in the center of the town, causing further loss. The shock was felt, to a less extent, in the neighboring villages. (Associ Pr.)

Valparaiso, Chile, May 21, 1918.
It is reported that there was loss of life in the earthquake yesterday at Serena. (Assoc. Pr.)

Santa Fe, N. Mex., May 28, 1918.
An earthquake shock was felt in Santa Fe at 5:30 o'clock this morning and was heavy enough to shake plaster off the walls of houses. No serious damage has been reported. (Assoc. Pr.)

[1] Reported by the organization indicated and collected by the seismological station at Georgetown University, Washington, D. C.

PROPAGATION OF EARTHQUAKE WAVES THROUGH THE EARTH.

Dr. C. G. KNOTT.

(*Abstract* of paper before Royal Society of Edinburgh, Jan. 14, 1918.)

[*Reprinted from* Nature, London, Feb. 21, 1918, 100:499.]

When a large earthquake occurs at any part of the earth elastic waves are sent out in all directions through the earth, emerging at the surface as disturbances which can be recorded on delicate seismometers. Up to about 120° from the epicentre, the times at which these variations emerge after the time of occurrence of the earthquake were first tabulated by J. Milne. The increasing number of observations and the improvement of the instruments have led to the tabulation of more accurate data than was possible in the earlier days. Following up certain calculations made in 1908, Dr. Knott, using these more recent data, has made fresh calculations of the velocities of the seismic waves through the earth by a mathematical method based on the theory of integral equations and entirely free from assumptions. As has long been recognized, two types of wave are transmitted through the body of the earth known as the primary (P) and the secondary (S) waves. The broad results of the investigation may be stated thus: The velocity of the P wave increases steadily with depth from 4.46 miles (7.18 kilometers) per second at the surface to 6.2 miles (10 km.), per second at a depth of 400 miles (650 km.), continuously increasing at a slightly smaller rate of increase until it reaches 7.95 miles (12.8 km.) per second at a depth of 1,000 miles (1,600 km.), after which, at greater depths, the speed of propagation remains constant. The S wave travels more slowly than the P wave, but changes in very much the same way, the values of the speed being 2.47 miles (3.98 km.) per second at the surface, 3.43 miles (5.53 km.) at a depth of 400 miles, and 4.25 miles (6.84 km.) at depths greater than 1,000 miles.

SECTION VI.—BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Australia. Commonwealth bureau of meteorology.
Rain map of Australia [and Tasmania] for the years 1916–1917. [Melbourne. 1918.] 2 maps. 1916: 72½ x 56 cm.; 1917: 63½ x 51 cm.

[British Guiana. Department of science and agriculture.]
Report on meteorology for the calendar year 1916. [Georgetown. 1918.] 45 p. incl. tables. 33½ cm. Appendix 7.

Connor, A. J.
Agricultural meteorology. Relation of the weather to the yield of wheat in Manitoba. Ottawa. 1918. 11 p. incl. chart. tables. 15 cm. At head of title: Department of trade and commerce, Canada. Dominion bureau of statistics, Ottawa. (Reprinted from the Monthly bulletin of agricultural statistics, April, 1918.)

Denmark. Meteorologiske institut.
Nautisk meteorologisk aarbog. Nautical meteorological annual, 1917. Kjøbenhavn. 1918. lviii, 134 [4] p. map. charts. tables. 31 cm. At head of title: Publikationer fra det Danske meteorologiske institut, ved. C. Ryder, direktør. Aarbøger.

Fowle, Frederick E[ugene].
The atmospheric scattering of light. Washington. 1918. p. l., 12 p. incl. charts. tables. 24½ cm. Smithsonian miscellaneous collections, v. 69, no. 3. (Publication 2495.)

Great Britain. Meteorological office.
The seaman's handbook of meteorology. A companion to the barometer manual for the use of seamen. Third edition. London. 1918. xxxviii, 202 p. illus. plate. maps (part. fold.) charts (part. fold.) tables. 24½ cm. M. O. 215 (1917).

Great Britain. Meteorological office. Advisory committee on atmospheric pollution.
Report on observations in the year 1915–1917 forming the second–third report of the committee for the investigation of atmospheric polution. London. 1916–[1918]. 2 v. maps. tables. charts. 28½ cm.

Hall, A[lfred] D[aniel].
The book of the Rothamsted experiments. Second edition; rev. by E. J. Russell . . . New York. 1917. xl, 332 p. incl. charts. tables. 25½ cm. [Meteorological observations, p. 15–23.]

Jinsen. Meteorological observatory.
Annual report of the Meteorological observatory of the Government-general of Chosen for the year 1916. Jinsen. 1918. p. l., 144 p., l. fold. map. tables. 30½ cm.

Lamb, Edmund.
Climatological observations, taken at Borden Wood, in the Parish of Chithurst, County of Sussex, during the year 1917 . . . Liphook, Hants. 1918. [4] p. incl. tables. 26½ x 33 cm.

Moore, Henry Ludwell.
Forecasting the yield and the price of cotton. New York. 1917. vi, [1] 173 p. incl. charts. tables. 22½ cm. [Deals with the correlation between crops and weather.]

Mosier, J[eremiah] G[eorge].
Climate of Illinois. Urbana, Ill. 1918. 125 p. incl. maps. charts. tables. 23 cm. At head of title: University of Illinois. Agricultural experiment station. Bulletin no. 208.

Oña. Colegio máximo de la Compañía de Jesús.
Observaciones meteorológicas hechas [año 1917] en el Colegio máximo de la Compañía de Jesús en Oña, Provincia de Burgos. Oña. 1918. unp. tables. 24 cm.

Pealing, H.
On the effect of vegetation on the rainfall of South Africa. (Excerpted from South African journal of science, Cape Town. v. 14, no. 3. Oct. 1917. p. [142]–145.) 24½ cm.

Rio de Janeiro. Observatorio nacional.
Annuario . . . Para o anno de 1918. Anno 34. Rio de Janeiro, 1918. vii, 524 p. fold. chart. tables. 18½ cm. At head of title: Ministerio da agricultura, industria e commercio. [Meteorology, p. 269–437.]

Spain. Observatorio central meteorológico.
Anuario. Suplemento al tomo 2. Madrid. [1918] p. l., 179 p., 2 l. 3 fold. charts. tables. 32 cm. At head of title: Dirección general del instituto geográfico y estadístico . . .
Resumen de las observaciones efectuadas en las estaciones del Servicio meteorológico español durante el año 1915 . . . v. 11. Madrid. 1917. ci, l., 555 [2] p. fold. map. tables. 24 cm. At head of title: Dirección genéral del instituto geográfico y estadístico . . .

Toronto observatory.
Results of meteorological, magnetical, and seismological observations, 1917 . . . Toronto. 1918. ix, 43 p. tables. 20 cm. At head of title: Department of marine and fisheries. Dominion of Canada.

Uruguay. Instituto nacional físico climatológico.
Sinopsis meteorológica del año 1916, por Luis Morandi, director. Montevideo. 1917. cover-title. 29 p. illus. charts. tables. 29 cm. At head of title: Instituto nacional físico climatológico. Observatorio central.–Prado-Montevideo.

Vinall, H[arry] N.
Effect of temperature and other meteorological factors on the growth of sorghums, by H. N. Vinall and H. R. Reed. Washington. 1918. cover-title. plate. tables. 26cm. (Reprinted from Journal of agricultural research, Wash. v. 13, no. 2. April 8, 1918. p. 133–147.)

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

Geographical journal. London. v. 51. May, 1918.
Can the climate of Kalahari be improved? p. 337.

Geographical review. New York. v. 5. 1918.
Brooks, Charles F. The "old-fashioned winter of 1917–18. p. 405–414. (May.)
Huntington, Ellsworth. The sun and the weather: new light on their relation. p. 483–491. (June.)
Jefferson, Mark. The rainfall of Java. p. 492–495. (June.)

Nature. London. v. 101. May 30, 1918.
Clouds at the royal academy. p. 244–245. [See this REVIEW, p. 235.]
Climatology and an abandoned flying school. p. 247–248. [Cites an example of the disastrous financial results of the neglect of climatology.] (See above, p. 210.)

Royal society. Proceedings. London. ser. A. v. 94. A 662. 1918.

Strutt, R. J. Scattering of light by dust-free air, with artificial reproduction of the blue sky. Preliminary note. p. 453–459.

S., A., & W., G. W. Prince Boris Galitzin (1872–1916). p. xxv–xxxi. Obituary.

Science. New York. v. 47. June 7, 1918.

Brooks, Charles F. The "old-fashioned" winter of 1917–18. p. 565–566.

Scientific American supplement. New York. v. 85. 1918.

Palmer, W. C. Tree planting to control snow and wind. Protection for the farmer and the railroad. p. 356–357. (June 8.)

Abbot, C. G., & Aldrich, L. B. The pyranometer. An instrument for measuring sky radiation. p. 364–365. (June 8.) [Repr. Smiths. Misc. Coll.]

Hucks, B. C. Danger in flying through clouds. p. 375. (June 15.) Abstract from a paper before the Aeronautical Society of Great Britain.

Illusions of the atmosphere and the traveling vortex. p. 403. (June 29.) [Abstract of lecture by Sir N. Shaw.]

Scientific monthly. New York. v. 7. July, 1918.

Ward, Robert DeC[ourcy]. Weather control over the fighting during the spring of 1918. p. 24–33.

Académie des sciences. Comptes rendus. Paris. Tome 166. 1918.

Perrotin, H. Sur la propagation de la chaleur dans les couches basses de l'atmosphère. p. 742–744. (6 mai.)

Yelénko, Mihailovitch. Résultats des études sur le tremblement de terre d'août et de septembre 1912 sur la mer de Marmara. p. 784–786. (13 mai.)

Astronomie. Paris. 32 année. Mai 1918.

Störmer, Carl. La théorie corpusculaire des aurores boréales. p. 153–162.

Hivers comparés depuis 45 ans. 176–177.

Revue du ciel. Bourges. 3 année. Juin 1918.

Moreux, Th[éophile]. Comment prévoir la pluie? p. 395–397.

Cassano, J. Les murailles météorologiques. p. 401–402.

Hemel en dampkring. Den Haag. 15 jaarg. Februari 1918.

Everdingen, E. van. Een feestdag voor halo-waarnemers. p. 155–158.

SECTION VII.—WEATHER AND DATA FOR THE MONTH.

THE WEATHER OF MAY, 1918.

P. C. DAY, Climatologist and Chief of Division.

[Climatological Division, Weather Bureau, July 2, 1918.]

PRESSURE AND WINDS.

The distribution of the mean atmospheric pressure over the United States and Canada and the prevailing direction of the winds for May, 1918, are graphically shown on Chart VII (XLVI–46), while the means at the several stations, with the departures from the normal, are shown in Tables I and III.

The month opened with high pressure central in the middle Mississippi Valley and clear cool weather thence westward to the Pacific. Over the more eastern districts low pressure prevailed, with a storm central over southern New England. Along the northern border between the Great Lakes and the Rocky Mountains a low-pressure area was moving eastward, but without precipitation.

The high pressure in the Mississippi Valley slowly drifted southeastward during the first week of the month, and clear weather prevailed not only in the South but very generally throughout the country. On the 6th low pressure developed in the Southwest and rapidly overspread the central and northeastern districts during the following few days. Again near the end of the first decade low pressure overspread the central Plains States, moving rapidly northeastward to the Great Lakes, attended by high winds in the latter region. A second area of low pressure followed a similar course, but farther to the southward in its earlier movement, during the succeeding two or three days, after which generally high pressure and clear weather prevailed until near the middle of the second decade. During the 15th and 16th pressure was low over the Rocky Mountains and Great Plains regions and continued generally below the normal in the middle western districts until the beginning of the third decade. After a few days of higher pressure in those regions low pressure again developed, continuing with slight interruption till the end of the month. At the same time pressure somewhat above the normal prevailed along the Pacific coast and over the southeastern States.

The average pressure for the month was above the normal from western Texas to the Great Lakes and thence eastward to the Atlantic, the region of greatest excess overlying the southeastern States, where departures ranged from 0.10 to 0.15 inch. Over the Pacific coast States pressure likewise averaged somewhat higher than normal. In the central and northern Plains regions, and the adjoining districts both eastward and westward, the average pressure for the month was below normal, and this condition was general over the adjoining districts of Canada.

Continued high pressure over the Southeast favored warm southerly winds to an unusual extent over nearly all districts from the Rocky Mountains eastward. In the Plateau and Pacific coast States the winds were mostly from some westerly point.

TEMPERATURE.

At the beginning of May fair and cold weather prevailed over the great central valleys, with light frosts in the northern portions of the Gulf States, while from the Rocky Mountains westward moderate temperatures prevailed. Cool weather moved rapidly to the Atlantic coast, and during the next few days there was a general rise in temperature throughout the country to the west. Seasonable weather prevailed thereafter until near the close of the first week.

Over the northeastern districts there was a sharp rise in temperature on the 6th and 7th and the weather generally continued warm, for the season, until near the end of the first decade when colder weather set in over the Northwest and West. This gradually moved into the middle Plains region, with freezing weather as far south as Nebraska and eastern Colorado.

No decided temperature changes occurred during the second decade except about the 17th when there were sharp rises in the Lake Superior Region and corresponding falls in the Northwest.

During the early part of the third decade there was a tendency toward higher temperatures over the central and eastern districts, and by the 25th high temperatures for the season prevailed in the Ohio and Mississippi Valleys and the Lakes Region. At the same time lower temperatures were observed in the Missouri Valley, and freezing weather with snow was reported at points in the Rocky Mountains Region. During the last few days of the month temperature was above the seasonal average east of the Rocky Mountains, except in the northern border States, while west of the Rocky Mountains it was below the normal with killing frosts in southern Nevada, eastern Oregon, and western Montana.

As a whole, May was warmer than normal from the Plains Region eastward, except in a few localities, the excesses ranging from 4 to 8 degrees over much of that region. From the Rocky Mountains westward the average temperature for the month was, nearly everywhere, somewhat lower than normal.

PRECIPITATION.

May, 1918, opened with generally fair weather throughout the country, except in the Atlantic coast districts where light rain prevailed. Early in the first week rain set in over the lower Rio Grande Valley and extended into western Texas and New Mexico. About the middle of the week heavy rain fell in eastern Texas and portions of Oklahoma and Kansas, and the week closed with general and beneficial rains from the Ohio and lower Missouri Valleys northward. From the Rocky Mountains westward the week, like a number of preceding weeks, was practically rainless.

At the beginning of the second week general showers and thunderstorms prevailed from Tennessee and the Ohio Valley northeastward, but the weather was fair in most other sections. During the next few days a storm moved from the Plateau region northeastward to the Canadian Maritime Provinces accompanied by general rains over the central and northern districts east of the Rocky Mountains, by considerable snow in the higher elevations of the Rocky Mountain districts, and by destructive local storms in the upper Mississippi Valley. Beneficial showers also occurred over considerable areas west of the Rocky Mountains. About the middle of the week rain fell in Oklahoma and from the Mississippi Valley eastward, the falls being heavy in the Ohio and middle Mississippi Valleys. The week closed with general rains from the east Gulf and South Atlantic States northeastward, rather heavy falls occurring in portions of Tennessee and North Carolina. Rain fell also in the upper Mississippi Valley, but elsewhere in the central valleys and Plains States the weather was generally fair.

During the early part of the third week rain fell in the immediate Atlantic coast districts, and there were showers in the western Lakes Region and far Northwest. About the middle of the week rains occurred from the Plains States and northern Texas to the upper Lakes and the Ohio Valley. Toward the close of the week showers occurred in the Northwest and local rains fell in the Atlantic coast States, the Ohio Valley, and Tennessee, the amounts being heavy in portions of peninsular Florida, Pennsylvania, and New York.

During the next several days showers occurred in the northern districts from Nevada and Idaho eastward to the Atlantic, good rains falling in most of Kansas and Nebraska and heavy amounts in portions of the lower Missouri and upper Mississippi Valleys, and snow fell in northern Wyoming, but generally fair weather continued in the South. The last few days of the month had rains in most northern and central districts east of the Rocky Mountains, with some heavy falls in the central Plains States, upper Mississippi Valley, and in Michigan. Elsewhere generally fair weather prevailed.

For the month as a whole fairly heavy precipitation occurred from the central and northern Plains States eastward to the Atlantic coast, but over the greater part of the Gulf States the precipitation was generally light and no rain occurred over considerable areas in the southern Plateau Region and portions of central and southern California.

RELATIVE HUMIDITY.

As a rule the relative humidity did not depart greatly from that usually experienced in May, although there were sharp differences between the values reported from near-by points. In the main, however, the relative amount of moisture was less than normal over the interior portions of the country and in the far West. Over the Lakes Region and along the Atlantic and Gulf coasts the month was on the whole relatively drier than normal.

GENERAL SUMMARY.

During the early part of the month the weather was cold and unfavorable for the proper development of vegetation, but later warmer and more seasonable weather obtained generally; however, in most sections winter grains, pastures, and meadows made good progress. The preparation of the land and the planting of corn were delayed by heavy rains in many central districts during the early part of the month, but good progress was made with this work as the month advanced. After the first few days the weather in the South was generally favorable for cotton and that crop made good progress, although in Arkansas the early planted was almost a complete failure, but that planted later progressed rapidly.

The weather as a whole was favorable for winter wheat which made excellent progress nearly everywhere. Spring wheat, while retarded somewhat by the cold, also progressed satisfactorily, as did other small-grain crops.

Potatoes and garden truck suffered some injury from frosts early in the month, and in exposed localities during the latter part of the month, yet there was good growth in nearly all sections.

In most central and eastern districts the weather was favorable for hay and pastures, but in some western sections the lack of moisture caused a deterioration of these crops. The condition of live stock was generally good except in the Southwest, where dry weather had prevented the usual growth of grass on the ranges.

Fruits of all kinds made excellent progress and gave promise of the usual yield.

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SEVERE LOCAL STORMS.

The following notes of severe storms have been extracted from the official reports of the various States. [All times here given are according to Normal Standard Time of the respective localities.]

Arkansas.—During the afternoon of May 10, 1918, a tornado moved over Mulberry, Crawford County, from the southwest. Its path was about 80 rods wide but it continued only a short distance. Estimated damagewas $8,000.

Several severe hailstorms occurred between May 7 and 13 at different points in the northern part of the State, doing much local damage.

Illinois.—On May 9, 1918, three distinct tornadoes occurred. The first started near Jacksonville, Morgan County, passed over Franklin at 2.30 a. m., in a path about 150 yards wide, killed two persons and destroyed $50,000 worth of property. What may have been the same storm next manifested itself at Lakewood, Shelby County, at 4 a. m., where 5 persons were injured, and $30,000 damage occurred. It passed through Effingham, Clay, and Richland Counties, causing about $50,000 loss and some personal injury. The other two tornadoes occurred in the evening of the same date. One passed through Stark and Bureau Counties, causing 3 deaths, the injury of 6 persons, and $22,000 property loss; the other passed through Ogle and Boone Counties, damaging farm property and many buildings in the town of Byron. The loss in Ogle County is estimated at $200,000 and in Boone County at $100,000. One person was injured.

May 12, 1918, about noon, a tornado started in northern Pope County and traveled across the southeastern corner of Saline County. Five dwellings and numerous farm buildings were destroyed; 1 person was fatally injured and 17 more or less severely injured.

May 21, 1918, a tornado began about 8 p. m. near the southeast corner of Stark County, moved northeastward into Marshall County, probably being the same storm that visited northern La Salle County at 10 p. m., and caused damage in the villages surrounding Aurora, Kane County. In Stark County several persons were injured, and property loss is estimated at $236,000. In La Salle County farm buildings were demolished.

Iowa.—A tornado swept over Lake and Bloomington townships, Muscatine County, about 6 p. m., May 9, 1918, injuring 8 persons and causing property loss of about $50,000. The tornado moved from southwest to northeast over a path about 500 feet wide and 9 miles in length.

About 6 p. m., May 9, 1918, a tornado appeared about 3½ miles southeast of Eldridge, Scott County, and moved in a northeasterly direction through the northern portion of that town, and disappeared about 4 miles northeast. Its path was about 600 feet wide. Many houses and outbuildings were damaged or destroyed, some live stock was killed or badly injured, and 11 persons more or less severely injured (1 of whom died), and 11 others slightly injured. Property loss was about $63,000. [See above, p. —, for detailed report.]

Kentucky.—Severe storms occurred on May 8. In Ballard County damage to buildings amounted to about $20,000; in Warren County two persons were killed and damage to houses and outbuildings estimated at $50,000; and in Simpson County a hailstorm caused much damage.

Pennsylvania.—A tornado occurred on the evening of May 25 near Smethport, McKean County. Property damage estimated at from $100,000 to $150,000. No lives were lost.

South Dakota.—A severe local storm about 7 a. m. May 18, 1918, caused considerable damage in Yankton

and Clay Counties, about 9 miles east of Yankton. The storm moved in a northeasterly direction, its path being about half a mile wide and 5 miles long. Several houses and many outbuildings were demolished, and numerous trees, some 3 feet in diameter, were twisted off. Six persons were injured, two seriously, and the estimated property loss was $30,000.

Wisconsin.—A tornado crossed the Mississippi River from Iowa into Wisconsin about a mile south of Glen Haven, Wis., shortly before 6.30 p. m. May 21, 1918, passed about 6 miles north of Lancaster, Grant County, at 7 p. m. and over Lone Rock, Richland County, at 7.30 p. m., Plain, Sauk County, at 8 p. m., and was last reported at Baraboo, in eastern Sauk County. Its path was from 100 feet to a quarter of a mile wide and about 85 miles long. Eight persons were killed, about 100 injured, and property loss, principally in houses and farm buildings, was estimated at $650,000.

Average accumulated departures for May, 1918.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
	° F.	° F.	° F.	In.	In.	In.	0-10.		P. ct.	
New England	58.4	+3.8	−6.0	2.64	−0.70	−1.10	5.4	−0.2	75	−1
Middle Atlantic	66.2	+4.5	+0.8	3.63	+0.10	−0.40	5.2	+0.1	67	−5
South Atlantic	72.0	+2.2	+4.5	2.43	−1.10	−5.30	4.3	−0.3	74	+1
Florida Peninsula	76.8	−0.9	+3.4	3.38	−0.90	−3.10	4.9	+0.6	70	−4
East Gulf	73.7	+1.5	+5.3	1.73	−1.80	−3.80	4.1	−0.7	64	−8
West Gulf	74.5	+1.4	+0.4	1.94	−2.20	−4.50	5.5	+0.6	75	0
Ohio Valley and Tennessee	69.6	+4.6	−0.8	4.02	+0.30	−1.90	4.3	−0.8	62	−6
Lower Lakes	62.0	+4.6	−2.1	3.15	0.00	−0.40	5.6	+0.2	70	0
Upper Lakes	54.9	+2.2	−4.7	4.79	+1.40	+1.40	5.8	+0.7	75	+3
North Dakota	52.4	−1.8	+13.8	2.37	−0.10	−0.30	5.8	+0.4	64	−1
Upper Mississippi Valley	66.0	+4.0	+0.2	5.71	+1.10	−0.90	5.4	+0.1	69	+1
Missouri Valley	65.0	+3.3	+6.0	4.37	−0.10	−1.10	5.2	−0.2	64	−1
Northern slope	51.5	−1.5	+2.7	1.84	−0.50	−0.40	5.8	+0.3	59	−2
Middle slope	65.4	+2.5	+1.6	3.56	−0.20	+0.20	5.2	+0.3	46	−16
Southern slope	71.5	+0.8	+5.9	2.70	0.00	−1.30	4.4	+0.1	48	−6
Southern Plateau	63.2	−2.7	−1.3	0.25	−0.10	−0.10	2.6	0.0	32	+1
Middle Plateau	56.5	−3.9	−2.7	0.57	−0.60	−1.20	4.1	0.0	38	−8
Northern Plateau	53.6	−3.2	+6.1	0.67	−0.10	−1.20	5.2	+0.1	49	−7
North Pacific	52.3	−1.5	+4.2	1.55	−1.20	−2.20	6.3	−0.1	74	−3
Middle Pacific	54.3	−1.8	+1.6	0.05	−1.20	−6.10	3.0	−0.9	73	+5
South Pacific	60.4	−1.1	+6.6	0.23	−0.40	+2.50	3.9	−0.1	67	−2

WEATHER CONDITIONS OVER THE NORTH ATLANTIC OCEAN DURING MAY, 1917.

The data presented are for May, 1917, and comparison and study of the same should be in connection with those appearing in the REVIEW for that month. Chart IX (XLVI—47) shows for May, 1917, the track of the principal storm, the averages of pressure, air temperature, and water surface temperature, also the prevailing direction of the wind at 7 a. m. 75th meridian time (Greenwich mean noon). Notes on the locations and courses of the more severe storms of the month are included in the following general summary.

PRESSURE.

The mean atmospheric pressure for the month was abnormal in nearly all respects. The North Atlantic or Azores HIGH, was very poorly developed, although the isobar of 30.05 inches covered a large area south of the Azores, as shown on Chart IX. The continental HIGH was also of slight intensity, and a LOW of 29.67 inches was central about 300 miles east of St. Johns, N. F. The gradients from north to south were less than usual over the eastern division, while they were somewhat steeper over the western, and the average pressure for the ocean as a whole was considerably below the normal. The following table gives for a number of selected 5-degree squares the average pressure for each of the three decades of the month, as well as the highest and lowest individual reading reported within the respective squares.

Pressure over North Atlantic Ocean during May, 1917, by 5-degree squares.

Position of 5-degree squares.		Decade means.			Extremes.			
					Highest.		Lowest.	
Latitude.	Longitude.	I	II	III*	Pressure.	Date.	Pressure.	Date.
°	°	Inches.	Inches.	Inches.	Inches.	May.	Inches.	May.
60-65 N	20-25 W	30.15	30.04	29.71	30.42	17	29.20	31
60-65 N	0- 5 E	30.11	30.17	29.97	30.41	11	29.62	30
55-60 N	35-40 W	30.02	29.72	29.70	30.24	11	29.36	20
55-60 N	10-15 W	30.16	29.97	29.79	30.35	5	29.36	31
50-55 N	55-60 W	30.05	29.53	29.79	30.23	2	29.39	20
50-55 N	0- 5 E	30.13	29.93	30.00	30.36	3	29.73	19
45-50 N	65-70 W	29.97	29.61	29.88	30.24	31	29.20	11
45-50 N	40-45 W	29.67	29.48	29.84	30.16	31	29.34	16
45-50 N	10-15 W	29.93	29.80	29.94	30.22	15	29.48	18
40-45 N	50-55 W	29.78	29.49	29.96	30.21	30	29.13	15
40-45 N	25-30 W	29.71	29.84	29.99	30.49	28	29.30	22
35-40 N	75-80 W	29.93	29.87	29.92	30.20	31	29.68	23
35-40 N	60-65 W	29.91	29.70	30.05	30.30	30	29.41	14
35-40 N	35-40 W	29.81	29.91	30.15	30.51	29	29.60	23
35-40 N	10-15 W	29.94	29.93	30.12	30.23	29	29.73	11
30-35 N	70-75 W	29.91	29.91	30.02	30.21	31	29.67	8
30-35 N	25-30 W	29.96	30.05	30.16	30.32	30	29.70	9
25-30 N	95-100 W	29.90	29.99	29.83	30.20	15	29.60	21
25-30 N	60-65 W	30.02	29.96	30.13	30.22	19	29.73	13
25-30 N	15-20 W	30.01	30.05	30.09	30.18	29	29.90	10
20-25 N	85-90 W	29.90	30.00	29.98	30.10	17	29.79	4
20-25 N	50-55 W	30.04	30.05	30.10	30.21	20	29.93	18, 23
10-15 N	25-30 W	29.99	30.02	30.00	30.10	22	29.91	28

* Means of last 11 days of the month.

The mean and extreme values presented in the above table are based on the pressures, for each square on the MS. daily synoptic charts of the North Atlantic compiled by the Marine Section of the Weather Bureau.

GALES.

The number of days on which gales occurred was somewhat less than usual over the greater part of the northern steamer lanes, as they were not reported on more than 2 days in any 5-degree square of that region. Over the southern tracks gales were more frequent, being reported on 4 days in each of the 3 squares between the 40th and 45th parallels and the 35th and 50th meridians, which was slightly above the normal for that locality.

From May 1 to 7 an area of low pressure, varying in intensity and extent, occupied some part of the region between the 40th and 50th parallels and the 25th and 45th meridians. The movement of the LOW was very irregular during this period. It reached its greatest depth on the 2d, with a barometer reading of 29.18 inches and northerly gales between the 50th meridian and the American coast. During the next 24 hours the eastward movement of the storm area was moderate, and one vessel near latitude 47° N., longitude 42° W., reported a northeasterly gale of over 50 miles an hour.

On the 5th a LOW was central near Norfolk, Va., moderate gales prevailing along the 40th parallel, between the 70th meridian and the coast, while fog was reported near its center.

On the 6th there was a disturbance (LOW *I* on Chart IX) about halfway between Brownsville and Del Rio, Tex. On the 7th the center was near Pensacola, Fla., where the barometer reading was 29.84 inches, with

light to moderate winds. This LOW continued in its easterly course with a comparatively uniform rate of translation, and on the 8th was a short distance south of Hatteras. The winds in this vicinity were still moderate, although one vessel in the Gulf of Mexico reported a northerly gale of 50 miles an hour. Low *I* then curved toward the northeast, and on the 9th was central near the 40th parallel, about 300 miles east of Philadelphia; moderate northerly and northwesterly winds were the rule along the coast as far south as Charleston while vessels near latitude 40°, longitude 70° encountered winds of gale force. This disturbance reached its greatest intensity on the 10th when its center was near Halifax, where the barometric reading was 28.96 inches, and westerly and southwesterly gales prevailed between the 40th and 45th parallels and the 60th meridian and the American coast.

The LOW remained practically stationary during the next 2 days, decreasing in intensity, light to moderate winds prevailing, with fog on the 12th off the Banks of Newfoundland. On the 14th a well-defined area of low pressure was central a short distance east of Sable Island, where the barometer reading was 29.06 inches. Northeasterly gales swept the coast of Nova Scotia, and high westerly winds prevailed over a limited area in the southern quadrants. This disturbance drifted slowly eastward, and on the 15th the center was near latitude 45°, longitude 51°, moderate winds with fog being reported off the Banks of Newfoundland. The LOW then curved toward the northeast, and on the 16th was in the vicinity of latitude 50°, longitude 42°; it had increased in intensity since the previous day, and westerly gales were prevalent between the 40th and 45th parallels and the 37th and 48th meridians. On the 19th a LOW of 29.02 inches was central near latitude 51°, longitude 47°, and on the same day a HIGH with a crest of 30.30 inches covered the territory between the 25th and 33d parallels and the 50th and 70th meridians. A number of vessels between the eastern part of the HIGH and the center of the LOW, reported moderate westerly and northwesterly gales. On the 20th the LOW began to fill in, and the HIGH had drifted slightly toward the southeast since the previous day, remaining about the same in intensity. A few reports of gales were received from vessels between the two areas, while others in the same vicinity experienced only moderate winds.

From the 21st to the 23d there were a number of slight atmospheric depressions over various portions of the ocean, but no reports of heavy winds during that period were received. On the 24th a LOW of 29.50 inches was central near latitude 48°, longitude 37°; moderate gales were encountered between the 34th and 39th meridians, and the observatory at Horta, Azores, recorded westerly winds of 48 miles an hour. From the 25th to the 28th a LOW of moderate intensity was over the Gulf of St. Lawrence; the maximum wind velocity during the period was 40 miles an hour, reported by vessels on the 26th between the 35th and 40th parallels and the 50th and 56th meridians. From the 27th to the 30th a low area of slight intensity extended along the American coast between Norfolk and Boston; light to moderate winds prevailed, and on the 29th fog covered an extensive area. On the 30th a LOW was central near latitude 58°, longitude 35°; vessels a short distance southwest of the center encountered northerly gales of over 60 miles an hour. This disturbance moved slowly eastward and on the 31st was near latitude 61°, longitude 20°; one vessel near the center recorded a barometer reading of 29.18 inches with easterly winds of hurricane force (over 90 miles an hour), while a second vessel about 5° east of the first encountered nearly as severe weather. On the same date the territory between the 48th and 56th parallels and the 35th and 40th meridians, was also swept by gales, wind velocities as high as 58 miles an hour being reported from that locality.

Comparatively few vessel reports were received from the eastern division of the Atlantic during the month, and it was difficult to determine the conditions of wind and weather between the 30th meridian and the European coast.

AIR TEMPERATURE.

The average temperature of the air over the ocean varied considerably during the month over different parts, when compared with the normal. In the waters adjacent to the American coast it was much cooler than usual, the negative departures ranging from 3 to 6 degrees. In the Gulf of Mexico and in the region between the 25th and 35th parallels, and the American coast and the 30th meridians, the departures were only slightly negative. Off the European coast they ranged from 0 to −2, and in the region of the northeast trades the temperatures were practically normal.

Off the European and Canadian coasts, as well as in mid-ocean, the seasonal rise in temperature was small, while in American waters between the 35th and 45th parallels the average temperature for the first decade was considerably below that of the last two.

The change in temperature from day to day was not specially marked, and off the coast of Newfoundland, where it is usually the greatest, the extremes were only 37° and 58°.

The following table gives the temperature departures at a number of Canadian and United States Weather Bureau stations on the Atlantic and Gulf coasts.

	°F.		°F.
St. Johns, N. F.	−2.2	Norfolk, Va.	−3.8
Sydney, C. B. I.	−3.6	Hatteras, N. C.	−4.5
Halifax, N. S.	−3.9	Charleston, S. C.	−2.2
Eastport, Me.	−3.7	Key West, Fla.	−1.2
Portland, Me.	−6.2	Tampa, Fla.	−0.8
Boston, Mass.	−5.9	Mobile, Ala.	−3.7
Nantucket, Mass.	−4.9	New Orleans, La.	−2.3
Block Island, R. I.	−3.7	Galveston, Tex.	−3.8
New York, N. Y.	−6.1	Corpus Christi, Tex.	−3.3

WATER SURFACE TEMPERATURE.

The variation in the average water temperature over different sections of the ocean, as compared with the normal, was even more marked than that of the air; this was especially noticeable in the vicinity of the Banks of Newfoundland, where the Gulf Stream and the Labrador Current meet. In the 5-degree square that includes St. Johns, N. F., the departure was +5° while in the square between latitudes 45°–50°, longitudes 35°–40°, it was −3°. In American waters, including the Gulf of Mexico, negative departures were the rule, while along the European coast they were slight but positive. The daily variation of water temperature was, as usual, most pronounced in the square that includes the east coast of Labrador, where the range was from 31° on May 1 to 47° on May 16.

FOG.

The number of days on which fog was observed was considerably less than usual off the Banks of Newfoundland, where the normal percentage ranges from 40 to 45. In May, 1917, fog was reported in that locality on only 2 days, a percentage of 6. It occurred on 4 days in each of the squares between latitudes 40°–45° and longitudes 45°–65°, and on 5 days in the Azores square, which was unusual for that region where fog is comparatively rare.

HAIL AND SNOW.

Hail was observed on 1 day in three 5-degree squares in the northern steamer lanes, while snow was reported on 1 day by a vessel off the coast of Newfoundland.

Winds of 50 mis. /hr. (22.4 m./ sec.) or over, during May, 1918.

Station.	Date.	Velocity.	Direction.	Station.	Date.	Velocity.	Direction.
		Mis./hr.				*Mis./hr.*	
Buffalo, N. Y.	2	66	sw.	Erie, Pa.	10	54	w.
Do.	7	54	sw.	Green Bay, Wis.	9	60	n.
Do.	10	68	w.	Huron, S. Dak.	9	68	ne.
Do.	12	58	w.	Do.	18	56	s.
Cairo, Ill.	11	57	sw.	Kansas City, Mo.	9	52	w.
Cleveland, Ohio.	22	50	nw.	Lincoln, Nebr.	9	58	nw.
Columbus, Ohio.	12	53	w.	Louisville, Ky.	9	56	sw.
Drexel, Nebr.	15	54	sw.	Do.	12	50	sw.
Duluth, Minn.	1	62	w.	Marquette, Mich.	19	52	s.
Do.	21	50	ne.	Minneapolis, Minn.	25	56	nw.
Ellendale, N. Dak.	16	52	nw.	Mt. Tamalpais, Cal.	3	59	w.
Do.	18	61	se.	Do.	4	88	nw.

Winds of 50 mis. /hr. (22.4 m./ sec.) or over, during May, 1918—Contd.

Station.	Date.	Velocity.	Direction.	Station.	Date.	Velocity.	Direction.
		Mis./hr.				*Mis./hr.*	
Mt. Tamalpais, Cal.	7	56	sw.	Pt. Reyes Light, Cal.	20	51	nw.
Do.	8	64	sw.				
Do.	9	66	nw.	Do.	24	59	nw.
Do.	13	80	n.	Do.	25	70	nw.
Do.	14	64	n.	Do.	26	62	nw.
Do.	15	56	n.	Do.	27	53	nw.
Do.	17	68	n.	Do.	28	53	nw.
Do.	26	84	nw.	Providence, R. I.	6	54	nw.
New York, N. Y.	1	54	nw.	St. Joseph, Mo.	9	51	nw.
Omaha, Nebr.	9	50	n.	St. Louis, Mo.	6	51	sw.
Pierre, S. Dak.	9	52	n.	St. Paul, Minn.	16	56	s.
Pt. Reyes Light, Cal.	4	62	nw.	Do.	25	64	n.
Do.	5	70	nw.	Sioux City, Iowa.	9	60	n.
Do.	8	67	nw.	Do.	24	51	se.
Do.	13	61	nw.	Toledo, Ohio.	10	54	w.
Do.	14	56	nw.	Trenton, N. J.	10	60	w.
Do.	18	52	nw.	Wichita, Kans.	8	50	s.
				Do.	9	50	nw.

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by section, May, 1918.

Section.	Temperature.							Precipitation.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
	°F.	°F.		°F.			°F.		*In.*	*In.*		*In.*		*In.*
Alabama	72.9	+1.4	2 stations	100	25†	St. Bernard	34	2	2.51	− 1.46	Tuscumbia	6.46	Fort Deposit	0.14
Arizona	62.7	−2.3	Sentinel	103	20†	Fort Valley	12	30	0.11	− 0.22	Blue	1.20	44 stations	0.00
Arkansas	72.2	+3.4	Amity	102	30	Dutton	29	1	3.01	− 2.02	Mountain Home	10.50	Arkadelphia	0.15
California	59.0	−3.1	Greenland Ranch	108	4	Tamarack	9	9	0.37	− 0.85	Montgomery Creek	2.70	40 stations	0.00
Colorado	52.1	+1.0	2 stations	97	8†	Ashcroft	10	12	0.82	− 1.05	Hawthorne	2.96	6 stations	0.00
Florida	75.0	−0.8	Lake City	97	31	3 stations	46	2†	2.43	− 1.39	Wausau	8.32	Malabar	0.10
Georgia	73.0	+1.1	2 stations	102		2 stations	32	2	1.81	− 1.31	Clayton	5.62	Macon	0.11
Hawaii (April)	68.8	−1.3	Mahukona	88	19†	Waimea	48	7	19.96	+12.72	Honomanu Valley	83.87	Kula (Erehwon)	2.20
Idaho	50.6	−1.4	Hotspring	98	3	Grays Lake	12	6	1.12	− 0.65	Spencer	3.88	2 stations	T.
Illinois	67.1	+4.3	Mount Carmel	95	30	Morrison	26	1	5.21	+ 1.14	Anna	9.42	Casey	2.30
Indiana	67.2	+4.7	2 stations	103	28†	Huntingburg	24	2	4.97	+ 0.95	Huntingburg	11.65	Noblesville	1.62
Iowa	64.9	+4.4	Creston	98	9	4 stations	25	1	6.87	+ 2.30	Gilman	11.98	Glenwood	2.72
Kansas	67.6	+3.4	Ashland	100	24†	Goodland	25	10	4.24	+ 0.36	Arkansas City	10.77	Johnson	1.13
Kentucky	69.4	+3.8	Bowling Green	97	31	Junction City	28	2	4.29	+ 0.34	London	7.40	Greensburg	1.78
Louisiana	74.8	+0.8	Reserve	102	8	2 stations	40	1	2.03	− 2.29	Franklin	6.40	Alexandria	0.25
Maryland-Delaware	67.7	+4.6	Ferry Landing	98	27	Oakland	27	2	3.74	+ 0.39	Grantsville	5.75	Public Landing	2.22
Michigan	57.1	+2.9	Munising	97	6	2 stations	12	13	4.15	+ 0.69	Benzonia	7.60	Adrain	1.39
Minnesota	56.4	+2.5	Warren	96	5	Grand Rapids	11	14	4.39	+ 1.00	Fairmont	9.66	Hallock	1.05
Mississippi	73.6	+1.6	Tupelo	100	31	2 stations	37	2	1.58	− 2.97	Leaksville	4.07	2 stations	0.30
Missouri	68.3	+3.8	Caruthersville	100	30	Bethany	28	1	5.49	+ 0.68	Jackson	11.53	Amoret	2.42
Montana	49.3	−2.0	Medicine Lake	94	30	2 stations	11	10†	1.30	− 1.22	Lewistown	3.32	Rudyard	0.02
Nebraska	62.3	+3.2	2 stations	100	8	Kirkwood	23	1	3.97	+ 0.34	Blair	9.27	Haigler	1.34
Nevada	52.9	−1.8	Las Vegas	97	5	Paradise Valley	11	22	0.52	− 0.23	McGill	2.49	2 stations	T.
New England	59.7	+4.7	Patten	95	18	Van Buren	23	5	2.75	− 0.70	Burlington, Vt.	4.92	Houlton, Me.	0.39
New Jersey	64.6	+4.4	2 stations	93	28	Charlotteburg	31	17	4.94	+ 1.11	Hightstown	7.59	Sandy Hook	2.74
New Mexico	58.9	−0.9	Artesia	102	22	2 stations	15	11†	0.48	− 0.46	Clayton	3.12	14 stations	0.06
New York	61.0	+4.6	Wappinger Falls	93	6	Lake Placid Club	22	3†	3.97	+ 0.47	Lowville	8.04	Keene Valley	1.27
North Carolina	69.7	+3.0	2 stations	99	30†	Highlands	24	2	3.65	− 0.38	Henderson	6.79	Manteo	0.28
North Dakota	51.6	−1.0	Colgate	99	5	Dunseith	6	12	2.31	− 0.24	Melville	4.63	Pembina	0.30
Ohio	66.4	+5.6	Green	98	26	Peebles	26	2	4.49	+ 0.92	Summerfield	8.67	Toledo	1.60
Oklahoma	71.3	+3.6	Lawton	104	8	Wichita Natl. Forest	30	1	4.05	− 1.14	Guthrie	9.49	Broken Bow	0.86
Oregon	51.9	−2.0	4 stations	90	3†	Blitzen	10	8	1.06	− 1.38	Government Camp	6.37	2 stations	0.00
Pennsylvania	65.1	+5.2	Gettysburg	95	27	Ebensburg	21	2	5.04	+ 1.15	Grove City	8.37	Selinsgrove	1.81
Porto Rico	76.1	−1.0	Corozal	95	27	Maricao	51	2	6.44	− 0.84	Maricao	14.50	Central Aguirre	0.27
South Carolina	72.6	+1.1	5 stations	100	31	Landrum	31	2	3.48	+ 0.02	Florence No. 1	7.68	Meriwether	1.00
South Dakota	57.5	+2.4	Mitchell	98	4	McIntosh	21	22	3.56	+ 0.92	Yankton	8.34	Dumont	1.41
Tennessee	70.2	+3.1	3 stations	98	31	Mountain City	25	2	3.72	− 0.28	Union City	7.23	Memphis	0.99
Texas	74.6	+1.5	0-2-Ranch	106	27	2 stations	30	1†	2.40	− 1.26	Matagorda	9.71	2 stations	0.05
Utah	53.0	−1.3	St. George	92	3†	Black's Fork	6	9	0.98	− 0.17	Ibapah	3.46	8 stations	0.00
Virginia	68.6	+3.8	Danville	99	30	Burkes Garden	28	2	3.24	− 0.67	Burkes Garden	6.37	Columbia	1.07
Washington														
West Virginia	66.7	+4.6	Martinsburg	97	27	Parsons	25	2	4.34	+ 0.74	Pickens	10.28	Union	1.85
Wisconsin	58.1	+3.5	Ashland	92	5	3 stations	16	13	6.66	+ 2.74	Hatfield	10.57	Florence	2.41
Wyoming	48.0	−0.8	New Castle	94	4	Dome Lake	2	11	1.90	− 0.30	Hecla	3.94	Encampment	0.35

† Other dates also.

DESCRIPTION OF TABLES AND CHARTS.

(*See* the Review, January, 1918, p. 48.)

TABLE I.—*Climatological data for Weather Bureau Stations, May, 1918.*

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.										Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles.*								*0–10*	*In.*	*In.*
New England.							**58.4**	**+3.8**											**75**	**2.64**	**−0.7**										**5.4**		
Eastport	76	67	85	29.94	30.02	+0.06	48.5	+1.6	78	18	56	35	5	40	38	43	39	75	1.50	−2.3	8	7,524	s.	37	nw.	15	6	13	12	6.2	0.0	0.0
Greenville, Me	1,070	6	....	28.84	30.00	.....	54.4	.....	87	18	66	27	5	43	46	.....	.....	.....	.....	3.37	.....	17	.....	.....	.....	8	15	8	....	0.0	0.0
Portland, Me	103	82	117	29.92	30.04	+ .07	56.6	+3.1	85	6	66	39	5	47	39	50	44	69	1.76	−1.9	11	7,410	s.	30	sw.	8	12	10	9	5.4	0.0	0.0
Concord	288	70	79	29.74	29.99	+ .01	61.0	+5.3	88	7	74	35	16	48	44	.....	.....	.....	.....	2.43	−0.8	11	4,065	s.	28	sw.	8	18	8	5	3.5	0.0	0.0
Burlington	404	11	48	29.59	30.02	+ .05	58.8	+4.9	84	18	69	32	5	49	38	.....	.....	.....	.....	4.92	+2.1	13	8,930	s.	45	s.	10	4	13	14	6.7	0.0	0.0
Northfield	876	12	60	.....	30.03	+ .06	57.4	+3.9	85	17	70	27	5	45	44	.....	.....	.....	.....	2.80	+0.3	15	6,386	s.	44	sw.	10	5	15	11	6.3	0.0	0.0
Boston	125	115	188	29.91	30.05	+ .07	63.3	+5.7	89	7	73	44	2	53	35	54	49	66	1.99	−1.5	13	7,990	sw.	37	w.	6	10	11	10	4.8	0.0	0.0
Nantucket	12	14	90	30.06	30.07	+ .08	55.5	+2.5	78	28	63	42	4	48	26	52	50	86	1.44	−1.2	12	12,162	sw.	37	sw.	10	10	14	7	5.5	0.0	0.0
Block Island	26	11	46	30.04	30.07	+ .08	55.8	+2.9	77	28	62	42	5	49	22	53	51	88	2.89	−0.9	10	12,030	sw.	44	w.	8	11	7	13	5.8	0.0	0.0
Narragansett Pier	....	9	....	.....	.....	.....	56.5	+1.8	82	28	66	36	5	47	31	.....	.....	.....	.....	2.44	.....	14	.....	sw.	.....	.....	.....	13	8	10	....	0.0	0.0
Providence	160	215	251	29.89	30.06	+ .08	62.0	+3.5	88	6	73	42	2	51	39	54	49	70	2.07	−1.4	13	8,870	sw.	54	nw.	6	9	16	6	5.0	0.0	0.0
Hartford	159	122	140	29.88	30.05	+ .07	63.4	+5.9	88	6	74	42	2	53	39	57	53	75	3.46	−0.1	14	6,433	s.	33	s.	10	12	11	8	4.7	0.0	0.0
New Haven	106	117	155	29.96	30.07	+ .08	62.2	+4.6	89	28	72	42	2	52	37	55	51	73	3.82	+0.2	11	6,348	s.	34	s.	10	10	11	10	5.2	0.0	0.0
Middle Atlantic States.							**66.2**	**+4.5**											**67**	**3.63**	**+0.1**										**5.2**		
Albany	97	102	115	29.92	30.03	+0.05	63.4	+4.5	85	7	74	39	5	53	36	56	50	65	2.78	−0.2	15	6,582	s.	37	s.	10	12	12	7	4.6	0.0	0.0
Binghamton	871	10	69	29.12	30.05	+ .07	63.1	+6.1	87	27	74	36	2	52	40	.....	.....	.....	.....	7.03	+3.9	14	3,689	s.	35	nw.	12	8	12	11	5.8	0.0	0.0
New York	314	414	454	29.73	30.06	+ .07	64.0	+4.7	86	28	73	42	2	55	25	56	52	70	3.37	+0.2	12	9,261	sw.	54	nw.	1	6	14	11	5.8	0.0	0.0
Harrisburg	374	94	104	29.68	30.07	+ .09	67.1	+5.4	91	27	78	42	2	57	32	59	53	65	2.95	−0.7	16	4,975	s.	47	sw.	10	7	15	9	5.7	0.0	0.0
Philadelphia	117	123	190	29.94	30.06	+ .07	67.2	+5.0	89	6	77	45	2	58	32	63	61	84	6.81	+3.6	13	7,574	s.	38	n.	27	8	9	14	6.0	0.0	0.0
Reading	325	81	98	29.73	30.07	.....	66.5	.....	90	27	77	42	2	56	32	58	52	66	4.00	+0.6	16	5,005	se.	29	nw.	28	7	8	16	6.6	0.0	0.0
Scranton	805	111	119	29.20	30.06	+ .08	64.6	+5.8	85	6	75	40	2	54	34	58	54	71	3.58	+0.1	18	5,447	sw.	37	sw.	10	6	9	16	6.6	0.0	0.0
Atlantic City	52	37	48	30.03	30.09	+ .11	60.8	+3.3	83	8	68	40	2	54	27	56	54	83	3.81	+0.8	11	5,614	sw.	25	s.	10	8	15	8	5.7	0.0	0.0
Cape May	18	13	49	30.00	30.12	+ .13	61.9	+3.3	82	6	69	46	2	55	28	.....	.....	.....	.....	3.16	+0.2	8	6,468	s.	30	nw.	1	11	15	5	....	0.0	0.0
Sandy Hook	22	10	57	30.05	30.07	.....	62.4	.....	85	28	71	45	2	54	30	57	55	83	2.74	.....	14	9,323	s.	45	nw.	1	10	12	9	5.3	0.0	0.0
Trenton	190	159	183	29.86	30.06	.....	65.2	.....	88	27	76	41	2	54	36	58	54	74	4.37	+0.8	14	8,290	s.	60	w.	10	7	10	14	6.3	0.0	0.0
Baltimore	123	100	113	29.96	30.08	+ .09	69.3	+5.1	94	27	79	43	2	60	31	61	56	68	3.17	−0.4	8	4,715	s.	22	ne.	21	7	16	8	5.5	0.0	0.0
Washington	112	62	85	29.96	30.08	+ .08	69.6	+5.4	93	28	81	42	2	58	35	62	56	67	2.35	−1.5	9	4,627	sw.	29	w.	28	7	18	6	5.0	0.0	0.0
Lynchburg	681	153	188	29.36	30.10	+ .10	70.0	+4.1	94	27	82	37	2	58	37	62	58	70	2.15	−1.8	12	4,761	w.	31	n.	1	6	20	5	5.1	0.0	0.0
Norfolk	91	170	205	30.02	30.12	+ .12	70.5	+4.3	93	27	80	46	2	61	30	63	59	73	2.97	−1.1	7	9,279	s.	44	s.	13	11	13	7	4.7	0.0	0.0
Richmond	144	11	52	29.95	30.10	+ .11	70.4	+3.1	94	27	81	39	2	60	36	62	57	68	3.30	−0.6	10	5,613	sw.	34	nw.	29	8	10	13	6.2	0.0	0.0
Wytheville	2,293	49	55	27.78	30.12	+ .13	64.5	+3.1	88	31	76	33	2	53	34	58	54	77	2.31	−1.6	12	4,072	w.	27	w.	10	10	18	3	4.3	0.0	0.0
South Atlantic States.							**72.0**	**+2.2**											**74**	**2.43**	**−1.1**										**4.3**		
Asheville	2,255	70	84	27.82	30.14	+0.15	65.8	+3.2	89	31	78	33	2	54	36	58	54	73	4.38	+0.6	11	4,687	s.	35	n.	26	7	18	6	5.4	0.0	0.0
Charlotte	773	153	161	29.30	30.12	+ .13	72.3	+3.9	96	31	83	41	2	62	33	63	59	70	2.92	−1.0	9	3,573	sw.	18	sw.	7	8	16	7	5.3	0.0	0.0
Hatteras	11	12	50	30.11	30.12	+ .11	69.8	+2.7	86	30	76	47	2	64	21	65	63	82	1.48	−2.7	9	9,374	sw.	37	sw.	1	17	8	6	4.3	0.0	0.0
Manteo	12	4	46	.....	.....	.....	69.6	.....	94	27	79	42	3	60	.....	.....	.....	.....	0.78	−3.3	3	.....	sw.	.....	.....	.....	19	5	7	....	0.0	0.0
Raleigh	376	103	110	29.72	30.11	+ .12	72.0	+3.9	94	30	82	41	2	62	29	65	61	75	4.18	−0.7	9	5,847	sw.	36	se.	11	10	11	10	5.3	0.0	0.0
Wilmington	78	81	91	30.06	30.14	+ .13	72.3	+3.2	93	31	81	45	2	64	33	65	62	76	1.52	−2.5	6	5,606	sw.	27	w.	8	16	9	6	3.9	0.0	0.0
Charleston	48	11	92	30.10	30.15	+ .14	73.2	+0.8	88	31	80	50	2	66	26	67	64	78	3.65	+0.2	5	7,181	s.	33	ne.	16	18	7	6	3.3	0.0	0.0
Columbia, S. C	351	41	57	29.76	30.14	+ .14	73.8	+2.0	95	31	84	45	2	64	33	64	58	65	1.56	−1.6	9	4,889	sw.	24	sw.	13	14	10	7	4.5	0.0	0.0
Greenville, S. C	1,013	113	122	29.03	30.11	.....	70.7	.....	94	31	81	40	2	61	32	63	58	71	5.61	.....	9	5,708	sw.	29	nw.	23	10	16	5	4.4	0.0	0.0
Augusta	180	62	77	29.93	30.12	+ .13	73.6	+1.4	94	31	84	44	3	63	36	66	63	73	2.05	−1.2	8	3,740	se.	24	nw.	1	16	6	9	4.5	0.0	0.0
Savannah	65	150	194	30.07	30.14	+ .14	73.5	+1.0	90	31	82	51	2	65	31	66	63	76	1.75	−1.2	6	7,801	se.	27	s.	12	18	7	6	3.7	0.0	0.0
Jacksonville	43	200	245	30.08	30.13	+ .13	74.2	0.0	89	31	81	58	3	67	22	67	64	75	2.50	−1.8	4	8,761	se.	42	ne.	11	18	11	2	3.2	0.0	0.0
Florida Peninsula.							**76.8**	**−0.9**											**70**	**3.38**	**−0.9**										**4.9**		
Key West	22	10	64	30.01	30.03	+0.06	77.8	−1.2	85	1	82	69	22	73	13	70	67	71	5.19	+1.8	11	9,503	e.	26	e.	24	16	7	8	4.4	0.0	0.0
Miami	25	71	79	30.06	30.09	.....	76.2	−2.4	82	31	80	63	9	73	17	69	66	69	2.80	−3.6	10	9,347	e.	31	e.	23	8	15	8	5.3	0.0	0.0
Sand Key	23	39	72	29.99	30.02	+ .05	76.6	.....	84	1	79	70	30	74	10	71	68	73	2.62	.....	10	14,744	e.	39	e.	24	18	4	9	4.4	0.0	0.0
Tampa	35	79	92	30.06	30.09	+ .10	76.4	+0.9	91	30	86	59	5	67	25	67	63	69	2.15	−0.8	4	5,499	ne.	27	ne.	25	5	16	10	5.5	0.0	0.0
East Gulf States.							**73.7**	**+1.5**											**64**	**1.73**	**−1.8**										**4.1**		
Atlanta	1,174	190	216	28.91	30.13	+0.14	72.2	+2.7	94	**31**	82	44	1	63	26	62	56	62	1.73	−1.4	6	6,056	se.	26	w.	8	15	10	6	4.3	0.0	0.0
Macon	370	78	87	29.74	30.14	+ .15	73.4	+2.3	94	31	84	43	3	62	36	64	58	63	0.11	−2.8	4	3,730	se.	22	s.	13	14	8	9	4.6	0.0	0.0
Thomasville	273	49	58	29.82	30.11	+ .12	74.3	+0.3	94	31	**96**	52	3	63	30	65	60	67	1.38	−2.6	3	3,095	ne.	17	sw.	13	15	11	5	4.2	0.0	0.0
Pensacola	56	149	185	30.04	30.10	+ .11	73.2	−1.6	83	24	78	54	2	68	17	68	66	81	1.15	−1.5	2	8,694	s.	34	s.	13	22	6	3	3.1	0.0	0.0
Anniston	741	9	57	29.36	30.14	+ .15	71.2	+2.8	94	31	84	39	2	59	37	.....	.....	.....	1.20	−1.9	2	3,319	s.	21	w.	13	19	10	2	3.1	0.0	0.0
Birmingham	700	11	48	29.36	30.12	+ .14	73.2	+1.6	93	31	84	43	1	63	30	63	58	66	4.07	+1.0	4	4,513	s.	25	s.	12	18	10	3	3.3	0.0	0.0
Mobile	57	125	161	30.04	30.10	+ .11	74.6	+1.0	89	23	82	53	2	67	24	69	67	83	2.90	−1.1	7	6,892	s.	29	se.	28	9	19	3	4.5	0.0	0.0
Montgomery	223	100	112	29.86	30.11	+ .12	74.6	+1.1	93	30	85	47	2	64	29	65	60	64	1.34	−2.5	2	4,231	se.	22	sw.	12	15	11	5	4.3	0.0	0.0
Corinth	469	6	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jackson	304	5	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meridian	375	85	93	29.70	30.08	+ .10	73.8	+2.7	91	31	84	47	2	64	30	65	60	66	1.66	−2.3	3	3,571	se.	20	sw.	12	16	13	2	3.9	0.0	0.0
Vicksburg	247	65	74	29.81	30.09	+ .12	74.6	+1.7	92	23	84	50	2	65	23	66	62	70	0.74	−3.5	2	5,096	s.	21	se.	11	7	21	3	5.3	0.0	0.0
New Orleans	51	76	84	30.02	30.07	+ .10	76.0	+1.5	88	31	84	56	2	68	19	70	68	79	2.79	−1.1	6	4,512	se.	22	se.	15	8	22	1	4.5	0.0	0.0
West Gulf States.							**74.5**	**+1.4**											**75**	**1.94**	**−2.2**										**5.5**		
Shreveport	249	77	93	29.76	30.03	+0.08	75.2	+2.0	92	23	85	49	2	65	26	66	62	68	1.49	−2.7	3	5,937	s.	26	s.	11	18	11	2	3.4	0.0	0.0
Bentonville	1,303	11	44	28.63	29.98	+ .05	69.4	+3.0	91	8	80	34	1	59	36	.....	.....	.....	3.07	−2.2	10	5,231	s.	24	s.	21	19	7	5	4.0	0.0	0.0
Fort Smith	457	79	94	29.50	29.97	+ .04	73.2	+3.5	95	8	83	42	1	63	31	66	62	70	3.64	−1.3	8	6,307	e.	39	s.	11	11	14	6	5.1	0.0	0.0
Little Rock	357	139	147	29.65	30.02	+ .07	74.1	+3.7	90	30	83	45	2	65	27	66	62	69	0.64	−4.5	6	7,020	s.	35	s.	9	9	15	7	5.0	0.0	0.0
Brownsville	57	4	26	.....	.....	.....	79.4	.....	94	26	88	58	14	71	26	.....	.....	.....	4.31	.....	7	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	0.0	0.0
Corpus Christi	20	69	77	29.95	29.97	+ .07	76.0	−0.5	84	31	79	61	1	73	14	72	71	86	2.38	−0.4	6	13,378	se.	42	se.	11	2	18	11	6.3	0.0	0.0
Dallas	512	109	117	29.44	29.98	+ .07	74.6	+1.4	91	30	84	50	1	66	29	.....	.....	.....	3.87	.....	4	8,876	s.	37	s.	11	5	19	7	5.5	0.0	0.0
Fort Worth	670	106	114	29.23	29.94	.00	75.2	−0.2	96	7	85	49	1	65	33	67	63	71	1.99	−2.2	4	10,288	s.	48	s.	11	3	17	11	6.0	0.0	0.0
Galveston	54	106	114	29.97	30.03	+ .09	75.2	−0.2	83	29	78	61	2	72	22	70	68	82	0.22	−3.0	2	10,676	se.	39	se.	11	3	19	9	6.6	0.0	0.0
Houston	138	111	121	29.86	30.01	.....	75.8	+0.3	89	29	83	56	2	68	23	.....	.....	.....	2.59	.....	5	7,766	se.	30	se.	11	3	23	5	5.7	0.0	0.0
Palestine	510	64	72	29.48	30.00	+ .07	75.0	+2.5	92	31	84	51	1	66	26	69	67	82	0.85	−4.0	4	6,593	s.	30	s.	11	5	7	19	6.8	0.0	0.0
Port Arthur	34	58	66	29.99	30.03	.....	75.2	.....	85	27	80	57	13	70	21	70	68	81	0.27	.....	5	8,601	s.	35	s.	11	16	10	5	4.0	0.0	0.0
San Antonio	701	119	132	29.24	29.95	+ .05	75.9	+1.1	94	31	85	55	3	67	28	67	64	73	2.80	−0.2	8	7,885	se.	32	nw.	12	12	11	8	5.1	0.0	0.0
Taylor	582	55	63	29.39	30.00	+ .09	74.6	+0.3	92	31	84	52	13	65	28	.....	.....	.....	2.27	−1.7	9	8,153	se.	37	s.	11	3	15	13	6.8	0.0	0.0

TABLE I.—*Climatological data for Weather Bureau Stations, May, 1918*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.										Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
Ohio Valley and Tennessee.							**69.6**	**+4.6**											**62**	**4.02**	**+0.3**									**4.3**		
Chattanooga	762	189	213	29.31	30.12	+0.13	71.2	+2.6	94	31	82	42	2	60	33	63	58	66	2.43	−1.2	6	4,868	sw.	38	s.	12	9	16	6	4.6	0.0	0.0
Knoxville	996	102	111	29.06	30.10	+ .11	70.2	+3.7	93	31	81	39	2	59	34	62	58	72	4.51	+0.8	7	4,090	sw.	38	sw.	12	14	10	7	4.6	0.0	0.0
Memphis	390	76	97	29.66	30.08	+ .12	74.6	+3.9	92	30	83	43	1	66	24	66	61	65	0.99	−3.4	3	6,321	s.	33	sw.	12	15	9	7	4.3	0.0	0.0
Nashville	546	168	191	29.52	30.10	+ .12	71.0	+2.2	93	31	82	39	2	60	34	63	58	67	3.61	+0.1	12	5,688	s.	36	s.	12	15	12	4	4.1	0.0	0.0
Lexington	989	193	230	29.04	30.09	+ .10	69.4	+5.1	91	28	78	36	1	60	25	.....	.....	.....	4.13	+0.6	9	9,699	sw.	44	sw.	12	16	9	6	4.2	0.0	0.0
Louisville	525	219	255	29.50	30.08	+ .10	71.2	+4.5	92	28	81	38	1	62	29	62	56	64	4.99	+1.4	10	8,483	sw.	56	sw.	9	13	14	4	4.1	0.0	0.0
Evansville	431	139	175	29.60	30.06	+ .09	71.9	+4.8	93	30	82	38	1	62	28	63	58	66	5.75	+2.3	7	8,538	s.	49	s.	9	10	15	6	4.7	0.0	0.0
Indianapolis	822	194	230	29.16	30.04	+ .07	68.8	+5.5	90	31	79	35	1	59	32	60	54	64	3.85	−0.1	13	9,173	sw.	46	w.	10	13	12	6	4.8	0.0	0.0
Terre Haute	575	96	129	29.40	30.01	.....	69.3	.....	89	31	79	36	1	59	29	62	58	70	3.95	.....	10	7,986	s.	37	sw.	10	6	20	5	5.5	0.0	0.0
Cincinnati	628	11	51	29.39	30.06	+ .07	68.8	+5.7	90	31	79	36	1	58	32	60	55	66	4.05	+0.5	9	5,588	sw.	35	nw.	22	9	15	7	5.5	0.0	0.0
Columbus	824	173	222	29.19	30.06	+ .08	68.2	+5.9	91	28	79	38	1	58	29	60	55	67	4.39	+0.6	13	8,517	sw.	53	w.	12	8	15	8	5.6	0.0	0.0
Dayton	899	181	216	29.08	30.02	.....	68.2	+5.3	90	28	78	36	1	58	28	60	56	69	4.35	+0.5	9	8,240	sw.	42	w.	10	10	12	9	5.1	0.0	0.0
Pittsburgh	842	353	410	29.16	30.06	+ .07	67.6	+5.0	88	31	77	38	1	58	30	59	53	64	3.89	+0.6	14	8,276	sw.	49	sw.	29	8	8	15	6.0	0.0	0.0
Elkins	1,940	59	67	28.08	30.09	+ .09	63.8	+4.7	86	29	76	27	2	51	38	57	52	69	5.87	+1.9	13	3,923	s.	32	nw.	10	2	18	11	6.3	T.	0.0
Parkersburg	638	77	84	29.44	30.09	+ .10	69.0	+5.7	92	31	80	34	2	58	34	61	56	68	3.51	0.0	13	3,951	se.	33	nw.	27	12	9	10	5.2	0.0	0.0
Lower Lakes Region.							**62.0**	**+4.6**											**70**	**3.15**	**0.0**									**5.6**		
Buffalo	767	247	280	29.20	30.03	+0.06	58.0	+0.5	81	17	67	34	1	49	34	52	47	73	2.47	−0.6	13	11,825	sw.	68	w.	10	8	11	12	6.0	0.0	0.0
Canton	448	10	61	29.54	30.01	.....	58.2	+2.0	84	18	69	30	11	47	39	.....	.....	.....	3.91	+1.1	13	7,921	sw.	39	sw.	10	14	10	7	4.5	0.0	0.0
Oswego	335	76	91	29.65	30.02	+ .05	57.0	+2.3	82	20	67	35	11	47	33	52	47	73	4.70	+1.8	13	6,561	s	33	sw.	10	5	10	16	6.4	0.0	0.0
Rochester	523	97	113	29.47	30.04	+ .03	61.7	+5.0	85	18	72	37	11	51	36	54	49	68	1.75	−1.2	14	6,323	sw.	37	sw.	12	8	9	14	6.1	0.0	0.0
Syracuse	597	97	113	29.41	30.05	+ .07	61.8	+4.5	83	18	72	36	11	52	37	.....	.....	.....	3.35	0.0	16	8,177	s.	43	w.	10	5	15	11	6.0	0.0	0.0
Erie	714	130	166	29.26	30.03	+ .05	62.6	+5.3	87	26	72	35	11	53	35	56	51	70	2.94	−0.5	15	9,855	sw.	54	w.	10	6	16	9	5.6	0.0	0.0
Cleveland	762	190	201	29.22	30.04	+ .06	64.4	+5.9	87	25	74	34	1	55	32	58	53	70	4.02	+0.8	12	9,310	sw.	50	nw.	22	11	12	8	5.3	T.	0.0
Sandusky	629	62	103	29.34	30.02	+ .04	65.1	+5.9	90	31	75	37	1	56	30	58	54	69	4.16	+0.9	12	9,537	sw.	48	w.	10	7	14	10	5.8	0.0	0.0
Toledo	628	208	243	29.34	30.02	+ .05	65.2	+5.5	89	31	75	36	1	55	33	58	53	67	1.60	−1.7	11	11,063	sw.	54	w.	10	15	10	6	4.5	0.0	0.0
Fort Wayne	856	113	124	29.12	30.03	.....	66.0	+5.8	89	31	76	35	1	56	30	58	54	68	2.74	.....	10	7,800	sw.	41	w.	10	11	11	9	5.3	0.0	0.0
Detroit	730	218	245	29.23	30.02	+ .05	62.4	+4.5	87	31	74	35	1	51	38	55	50	71	2.64	−0.6	13	8,239	sw.	44	w.	7	8	15	8	5.6	0.0	0.0
Upper Lakes Region.							**54.9**	**+2.2**											**75**	**4.79**	**+1.4**									**5.8**		
Alpena	609	13	92	29.32	29.99	+0.02	52.0	+2.5	83	17	62	30	1	42	32	47	43	76	4.49	+1.2	13	8,931	se.	37	se.	15	6	12	13	6.5	0.0	0.0
Escanaba	612	54	60	29.29	29.96	− .01	49.4	−0.6	72	18	57	29	1	41	29	46	43	84	5.77	+2.4	15	8,110	s.	44	n.	9	12	10	9	5.1	T.	0.0
Grand Haven	632	54	92	29.29	29.97	+ .01	57.0	+2.2	80	31	65	34	1	49	31	52	47	72	2.26	−1.1	12	9,430	s.	44	s.	9	14	12	5	4.5	0.0	0.0
Grand Rapids	707	70	87	29.22	29.99	+ .02	61.8	+2.8	90	31	72	32	1	52	35	55	50	68	4.03	+0.7	14	5,025	w.	31	w.	9	10	13	8	5.5	0.0	0.0
Houghton	684	62	99	29.19	29.92	− .05	50.0	+0.3	89	5	60	29	13	40	48	.....	.....	.....	6.38	+3.1	16	8,069	e.	42	w.	22	5	11	15	6.7	0.0	0.0
Lansing	878	11	62	29.06	30.00	.....	61.1	+3.2	88	31	73	32	1	50	36	56	52	73	2.89	−0.7	16	4,946	sw.	36	sw.	9	7	15	9	6.2	0.0	0.0
Ludington	637	60	66	29.27	29.97	.....	53.7	.....	80	19	63	33	1	45	30	50	47	80	2.99	.....	14	8,513	s.	38	w.	9	10	10	11	5.5	0.0	0.0
Marquette	734	77	111	29.16	29.97	.00	50.8	+1.8	88	5	62	25	13	40	43	45	41	74	6.58	+3.3	16	8,810	nw.	52	s.	19	4	11	16	6.8	0.5	0.0
Port Huron	638	70	120	29.31	30.00	+ .03	57.0	+3.3	86	26	69	32	11	45	50	51	47	75	3.19	0.0	10	8,068	sw.	46	w.	10	13	13	5	4.1	0.0	0.0
Saginaw	641	48	82	29.30	29.99	.....	59.9	.....	89	31	71	31	1	48	41	54	49	69	3.28	−0.8	14	7,547	s.	40	w.	9	5	9	17	6.8	0.0	0.0
Sault Sainte Marie	614	11	61	29.29	29.99	+ .04	49.1	+1.4	82	17	59	29	1	39	41	45	42	78	5.74	+2.5	17	6,716	se.	38	nw.	20	6	12	13	6.3	0.0	0.0
Chicago	823	140	310	29.11	29.99	+ .03	63.7	+7.2	89	31	74	36	1	54	36	56	52	70	4.57	+1.2	13	10,170	sw.	40	sw.	9	13	13	5	4.6	0.0	0.0
Green Bay	617	109	144	29.27	29.92	− .03	57.6	+3.1	85	31	68	32	1	48	46	51	48	75	9.70	+6.1	15	8,977	s.	60	n.	9	7	14	10	6.5	0.0	0.0
Milwaukee	681	119	133	29.23	29.96	.00	57.2	+3.6	89	31	68	35	1	47	43	52	50	82	4.11	+0.7	13	7,840	sw.	38	sw.	9	9	14	8	5.3	0.0	0.0
Duluth	1,133	11	47	28.68	29.90	− .06	46.9	−1.7	87	5	57	27	13	37	47	42	36	71	4.07	+0.6	17	10,619	ne.	52	w.	1	7	10	14	6.6	0.0	0.0
North Dakota.							**52.4**	**−1.8**											**64**	**2.37**	**−0.1**									**5.8**		
Moorhead	940	8	57	28.87	29.88	−0.06	55.0	+0.2	95	5	68	20	12	42	48	48	42	68	2.72	−0.2	12	7,431	n.	30	se.	18	12	9	10	4.9	0.0	0.0
Bismarck	1,674	8	57	28.12	29.90	− .02	54.2	−1.0	92	4	67	23	12	41	50	46	37	60	2.03	−0.5	13	8,560	n.	45	w.	21	9	13	9	5.7	T.	0.0
Devils Lake	1,482	11	44	28.29	29.86	− .08	48.9	−3.8	90	4	61	15	12	37	49	43	36	68	3.69	+1.5	12	9,309	n.	40	n.	11	9	6	16	6.7	T.	0.0
Ellendale	1,457	10	56	28.31	29.87	.....	53.6	.....	88	5	67	24	12	40	50	48	42	69	3.27	.....	12	12,396	nw.	61	se.	18	7	10	14	6.2	0.0	0.0
Grand Forks	835	12	89	.....	.....	.....	51.8	.....	94	5	...	19	12	...	55	.....	.....	.....	3.20	.....	12	.....	nw.	39	se.	23	13	14	4	.....	0.0	0.0
Williston	1,872	41	48	27.88	29.85	− .08	51.5	−2.8	91	4	64	24	12	39	40	43	35	58	1.04	−1.2	5	7,668	w.	36	ne.	14	6	16	9	5.7	T.	0.0
Upper Mississippi Valley.							**66.0**	**+4.0**											**69**	**5.71**	**1.1**									**5.4**		
Minneapolis	918	10	208	28.85	29.82	.....	60.1	.....	88	3	70	33	13	50	33	.....	.....	.....	4.32	+0.4	15	9,539	se.	56	nw.	25	8	10	13	6.3	0.0	0.0
St. Paul	837	201	236	28.98	29.88	−0.06	59.8	+1.6	86	3	70	33	13	50	36	.....	.....	.....	4.52	+0.9	14	9,910	sw.	64	n.	25	10	13	8	5.4	0.0	0.0
La Crosse	714	11	48	29.15	29.92	− .02	62.7	+3.2	91	3	74	30	1	52	44	.....	.....	.....	6.55	+2.8	15	4,398	s.	24	sw.	31	9	11	11	5.9	0.0	0.0
Madison	974	70	78	28.91	29.94	− .02	61.0	+3.4	86	3	71	34	1	51	44	55	50	70	4.87	+1.2	14	7,337	s.	42	sw.	17	4	13	14	6.7	0.0	0.0
Wausau	1,247	4	.....	28.60	29.92	.....	56.9	.....	85	31	68	28	1	46	46	.....	.....	.....	7.85	.....	19	.....	se.	.....	.....	.....	12	6	13	5.4	T.	0.0
Charles City	1,015	10	49	28.84	29.90	− .04	62.6	+3.1	91	3	74	31	1	51	40	55	50	67	8.41	+3.5	13	6,512	s.	36	sw.	8	7	15	9	5.6	0.0	0.0
Davenport	606	71	79	29.30	29.95	.00	66.2	+4.7	87	31	76	35	1	56	33	59	54	69	7.15	+3.0	14	6,544	sw.	36	e.	21	7	17	7	5.4	0.0	0.0
Des Moines	861	84	97	28.99	29.88	− .05	67.2	+5.6	91	4	79	34	13	56	42	58	51	62	5.87	+1.3	15	7,957	sw.	44	sw.	9	7	13	11	6.0	0.1	0.0
Dubuque	698	81	96	29.21	29.95	.00	64.9	+4.1	89	4	75	33	1	55	32	57	51	66	8.64	+4.3	17	5,657	s.	38	se.	21	7	9	15	6.5	0.0	0.0
Keokuk	614	64	78	29.29	29.96	+ .02	67.8	+4.6	88	25	77	37	1	58	28	60	55	68	6.72	−2.5	12	6,904	s.	40	sw.	9	12	14	5	4.2	0.0	0.0
Cairo	356	87	93	29.65	30.02	+ .06	71.2	+3.7	91	30	80	40	1	62	26	63	59	70	5.15	+1.3	10	6,337	s.	57	sw.	11	12	9	10	4.6	0.0	0.0
Peoria	609	12	45	29.32	29.98	+ .02	66.4	+4.7	90	31	77	31	1	56	32	60	56	73	3.02	−1.2	15	5,731	s.	30	w.	9	12	14	5	4.3	0.0	0.0
Springfield, Ill	644	10	91	29.31	29.97	+ .02	68.6	+5.1	90	31	79	37	1	58	31	61	57	72	5.16	+0.7	11	6,794	s.	31	nw.	19	10	13	8	5.0	0.0	0.0
Hannibal	534	74	109	29.40	29.97	+ .03	68.2	+3.8	89	25	78	36	1	58	30	.....	.....	.....	6.21	+1.2	11	8,077	sw.	46	w.	9	11	14	6	4.8	0.0	0.0
St. Louis	567	265	303	29.39	29.99	+ .04	70.8	+4.3	90	30	80	43	1	62	28	63	59	71	3.28	−1.0	9	11,420	s.	51	sw.	6	10	15	6	4.8	0.0	0.0
Missouri Valley.							**65.0**	**+3.3**											**64**	**4.37**	**−0.1**									**5.2**		
Columbia, Mo	781	11	84	29.14	29.96	+0.02	68.8	+4.3	90	30	79	35	1	58	33	.....	.....	.....	3.95	−0.9	12	6,156	s.	39	s.	9	9	13	9	5.4	0.0	0.0
Kansas City	963	161	181	28.90	29.91	− .01	69.1	4.6	89	30	79	44	1	60	41	59	53	60	3.77	−1.3	13	10,185	s.	52	w.	9	14	11	6	4.3	0.0	0.0
St. Joseph	967	11	49	28.89	29.90	.....	69.4	.....	92	8	80	40	1	58	42	59	52	61	6.71	.....	13	7,568	s.	51	nw.	9	10	15	6	4.7	0.0	0.0
Springfield, Mo	1,324	98	104	28.59	29.98	+ .05	68.6	+4.0	89	8	78	39	1	60	33	61	57	71	4.19	−1.4	10	8,508	s.	46	w.	9	18	11	2	2.9	0.0	0.0
Iola	984	11	50	28.90	29.92	.00	68.8	+4.3	88	8	79	34	1	58	38	.....	.....	.....	4.91	−0.3	13	6,719	s.	37	sw.	8	8	14	9	5.5	0.0	0.0
Topeka	983	85	101	.....	.....	.....	69.1	.....	91	25	80	39	1	58	38	.....	.....	.....	7.14	+2.3	11	10,003	s.	44	sw.	9	12	14	5	4.2	0.0	0.0
Drexel	1,299	10	53	28.49	29.86	.....	65.7	.....	92	8	78	35	10	53	46	56	50	64	4.28	.....	11	11,578	sw.	54	sw.	15	10	12	9	5.4	0.0	0.0
Lincoln	1,189	11	81	28.60	29.84	− .07	68.0	+5.1	93	8	80	38	10	56	42	57	50	60	2.82	−1.1	10	9,532	s.	58	nw.	9	6	13	12	5.9	0.0	0.0
Omaha	1,105	115	122	28.71	29.87	− .05	67.8	+5.3	92	8	79	39	13	57	46	58	52	63	4.08	−0.4	12	7,040	s.	50	n.	9	11	13	7	4.9	0.0	0.0
Valentine	2,598	47	54	27.17	29.85	− .05	58.6	+0.7	89	15	71	31	10	46	42	50	42	63	1.39	−1.9	11	8,350	nw.	43	nw.	31	6	14	11	6.1	T.	0.0
Sioux City	1,135	94	104	28.66	29.85	− .07	65.0	+4.2	92	4	76	35	10	54	37	57	51	67	5.22	+0.8	12	11,426	s.	60	n.	9	9	14	8	5.4	0.0	0.0
Huron	1,306	59	74	28.48	29.86	− .06	58.5	+1.2	89	4	72	33	9	45	46	52	46	69	3.62	+0.7	13	9,422	se.	68	ne.	9	9	14	8	5.6	0.0	0.0
Pierre	1,572	70	75	28.19	29.84	− .07	59.2	−0.1	90	4	72	34	10	46	45	50	44	66	3.02	+0.9	11	7,613	e.	52	n.	9	12	8	11	5.6	T.	0.0
Yankton	1,233	49	57	28.54	29.84	− .08	62.8	+2.8	93	8	74	35	10	52	40	.....	.....	.....	8.34	+4.4	14	7,365	se.	46	ne.	9	4	18	9	6.4	0.0	0.0

TABLE I.—*Climatological data for Weather Bureau Stations, May, 1918*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.										Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F		°F	°F.		°F	°F.		°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
Northern Slope.							51.5	−1.5											59	1.84	−0.5										3.8		
Billings	3,140	5	....				51.6	−2.5	85	3	65	25	26	38	45		43	34	59	0.13	−2.0	3	6,004	sw.	30	sw.	3	9	13	9	5.8	T.	0.0
Havre	2,505	11	44	27.26	29.88	−0.02	48.6	−3.0	81	3	59	27	10	38	41		38	27	50	1.36	−0.6	7	6,820	sw.	28	sw.	12	5	12	14	6.5	5.1	0.0
Helena	4,110	87	114	25.73	29.92	− .01	48.3	−2.7	78	3	60	25	26	36	40		39	29	55	0.43	−1.6	5	5,017	nw.	30	sw.	30	10	10	11	5.7	0.2	0.0
Kalispell	2,962	11	34	26.88	29.91	+ .03	55.8	+0.9	90	4	67	31	9	44	38		47	41	64	1.75	−0.2	11	5,279	nw.	30	n.	8	11	12	8	5.0	0.4	0.0
Miles City	2,371	48	55	27.38	29.92	+ .01	55.4	+1.2	85	15	67	32	9	44	40		46	36	56	4.10	+1.2	15	7,673	n.	46	n.	31	6	15	10	5.9	0.5	0.0
Rapid City	3,259	50	58	26.50	29.89	− .01	49.4	−2.6	80	4	63	25	10	36	40		40	30	58	1.98	−0.9	10	3,040	w.	26	sw.	8	8	16	7	5.9	8.1	0.0
Cheyenne	6,088	84	101	23.92	29.82	− .03	50.6	....	85	4	63	28	9	38	42		43	36	64	2.83	....	16	4,622	nw.	39	nw.	20	5	9	17	6.5	1.3	0.0
Lander	5,372	60	68	24.56	29.87	− .01	50.7	−0.3	75	15	63	26	10	38	34		41	32	58	2.60	+0.2	12	10,155	w.	49	w.	12	2	19	10	6.4	4.7	0.0
Sheridan	3,790	10	47	26.03	29.92	.....	49.4	−2.6	80	4	63	25	10	36	40		40	30	58	1.98	−0.9	10	3,040	w.	26	sw.	8	8	16	7	5.9	8.1	0.0
Yellowstone Park	6,200	11	48	23.80	29.90	− .01	42.5	−4.9	72	4	54	21	11	32	35		35	28	66	1.95	−0.0	16	6,708	s.	33	s.	24	7	16	8	5.5	8.0	0.0
North Platte	2,821	11	51	26.97	29.86	− .02	61.6	+2.6	92	15	76	33	10	48	42		51	44	64	2.30	−0.8	9	6,551	s.	40	nw.	9	13	6	12	5.1	T.	0.0
Middle Slope.							65.4	+2.5											46	3.56	−0.2										5.2		
Denver	5,292	106	113	24.63	29.81	−0.03	57.6	+0.9	83	8	70	30	10	45	35		45	33	47	1.73	−0.8	6	6,209	se.	40	ne.	9	7	21	3	5.3	4.7	0.0
Pueblo	4,685	80	86	25.18	29.79	− .04	61.2	+1.7	89	23	76	34	10	46	42		46	31	40	0.06	−1.6	2	6,382	w.	39	nw.	9	8	15	8	5.4	0.0	0.0
Concordia	1,392	50	58	28.42	29.87	− .04	67.8	+4.1	91	8	79	40	10	57	39		58	50	59	2.52	−2.2	9	9,197	s.	44	nw.	9	9	15	7	5.5	0.0	0.0
Dodge City	2,509	11	51	27.27	29.83	− .04	67.0	+3.6	94	24	80	35	10	54	41		56	50	62	2.90	−0.4	9	10,602	s.	46	se.	28	13	12	6	4.7	0.0	0.0
Wichita	1,358	139	158	28.47	29.88	− .02	68.0	+2.1	87	27	78	41	10	58	37		61	56	69	5.86	+0.9	11	13,017	s.	50	s.	8	10	16	5	5.1	0.0	0.0
Altus	1,410	5	....				74.4	.....	103	8	88	40	1	61	41		.....	.....	.....	1.97	.....	7	.....	s.	.....	.....	.....	16	4	11	.....	0.0	0.0
Muskogee	652	4	....				70.7	.....	91	8	81	38	1	60	37		.....	.....	.....	3.87	.....	10	.....	s.	.....	.....	.....	9	1	21	.....	0.0	0.0
Oklahoma	1,214	10	47	28.65	29.91	+ .02	71.0	+2.9	96	8	82	43	10	61	40		62	56	64	8.31	+2.6	8	12,469	s.	48	n.	19	6	16	9	5.6	0.0	0.0
Southern Slope.							71.5	+0.8											48	2.70	0.0										4.4		
Abilene	1,738	10	52	28.12	29.88	+0.01	74.8	+2.9	99	7	86	46	1	63	38		61	51	53	2.88	−0.8	4	10,711	s.	32	s.	30	11	12	8	5.0	0.0	0.0
Amarillo	3,676	10	49	26.19	29.85	+ .01	67.5	+3.3	93	24	82	35	10	54	43		53	42	51	2.23	−1.4	9	8,943	s.	32	w.	8	19	8	4	3.8	0.0	0.0
Del Rio	944	64	71	28.93	29.90	+ .05	75.8	−1.1	96	11	84	52	3	68	27		.....	.....	.....	5.10	+2.7	5	9,723	se.	37	ne.	3	6	23	2	4.8	0.0	0.0
Roswell	3,566	75	85	26.27	29.81	− .01	67.8	−1.6	93	22	83	38	12	52	42		52	38	41	0.59	−0.6	4	7,730	s.	38	sw.	30	14	15	2	3.9	0.0	0.0
Southern Plateau.							63.2	−2.7											32	0.25	−0.1										2.6		
El Paso	3,762	110	133	26.11	29.79	+0.01	69.8	−2.3	94	23	83	44	2	57	35		49	76	25	0.05	−0.3	1	9,465	w.	48	sw.	30	16	10	5	3.5	0.0	0.0
Santa Fe	7,013	57	66	23.21	29.79	− .02	55.7	−1.0	78	23	67	31	12	44	30		41	26	36	1.02	−0.1	3	7,018	sw.	47	s.	30	16	14	1	4.0	T.	0.0
Flagstaff	6,908	8	57	23.29	28.80	+ .02	46.8	−3.9	71	23	62	18	30	31	44		.....	.....	.....	0.01	.....	1	.....	sw.	44	sw.	8	23	8	0	....	0.1	0.0
Phoenix	1,108	76	81	28.67	29.81	+ .03	72.2	−2.6	95	14	88	49	12	56	41		53	34	29	T.	0.0	0	4,710	w.	29	e.	3	25	6	0	1.9	0.0	0.0
Yuma	141	9	54	29.68	29.82	− .02	74.6	−2.2	99	14	90	52	25	59	40		56	41	37	T.	0.0	0	4,862	w.	30	se.	3	31	0	0	0.5	0.0	0.0
Independence	3,910	11	42	25.87	29.87	+ .03	60.4	−4.1	88	3	75	34	9	46	40		44	26	34	0.18	0.0	2	.....	nw.	20	w.	26	20	5	6	3.5	0.0	0.0
Needles	488	4	....	29.28	29.77	.....	75.1	.....	103	3	93	49	29	58	46		.....	.....	.....	T.	.....	0	.....		.....	.....	.....	16	9	6	2.2	0.0	0.0
Middle Plateau.							56.5	−3.9											38	0.57	−0.6										4.1		
Reno	4,532	74	81	25.41	29.90	−0.01	52.8	−0.8	80	3	67	32	9	38	42		40	28	46	0.25	−0.5	2	6,359	w.	36	w.	4	18	10	3	3.2	T.	0.0
Tonopah	6,090	12	20	23.96	29.82	.....	51.5	.....	77	3	63	26	10	40	31		42	34	54	0.34	−1.0	6	7,292	nw.	33	nw.	26	18	11	2	3.1	2.5	0.0
Winnemucca	4,344	18	58	25.54	29.91	.00	51.6	−2.8	84	3	68	28	22	35	48		39	25	46	0.77	−0.3	6	4,984	sw.	28	sw.	13	18	8	5	3.3	T.	0.0
Modena	5,479	10	43	24.50	29.80	−.02	51.0	−3.5	80	4	67	25	28	35	45		37	20	35	0.69	−0.2	4	10,202	sw.	48	s.	8	12	12	7	4.6	0.3	0.0
Salt Lake City	4,360	163	203	25.49	29.82	−.04	56.4	−1.9	83	4	66	38	9	47	30		45	33	48	1.33	−0.6	9	6,478	nw.	36	e.	29	7	14	10	5.7	0.0	0.0
Grand Junction	4,602	82	96	25.25	29.77	−.06	61.1	−0.5	84	23	75	32	12	48	38		43	21	26	0.05	−0.9	2	5,863	sw.	41	sw.	10	9	17	5	4.8	0.0	0.0
Northern Plateau.							53.6	−3.2											49	0.67	−0.1										5.2		
Baker	3,471	48	53	26.39	29.97	+0.01	48.3	−2.4	83	3	61	24	25	35	41		39	30	54	0.02	−1.7	1	5,738	nw.	25	n.	27	12	12	7	4.7	T.	0.0
Boise	2,739	78	86	27.08	29.93	− .01	54.8	−2.8	88	3	68	30	25	42	40		43	30	46	1.05	−0.2	5	4,464	nw.	25	nw.	10	15	12	4	4.3	T.	0.0
Lewiston	757	40	48	29.17	29.98	+ .02	56.2	−4.6	89	3	70	34	26	43	43		.....	.....	.....	0.66	−1.0	7	3,077	ne.	25	nw.	18	7	13	11	5.4	0.0	0.0
Pocatello	4,477	60	68	25.36	29.85	− .04	52.4	−3.1	83	3	64	32	11	40	38		41	30	49	0.68	−1.5	8	7,037	sc.	42	sw.	31	11	7	13	5.4	0.0	0.0
Spokane	1,929	101	110	27.90	29.95	− .01	53.6	−2.5	83	3	64	36	27	43	37		43	31	49	0.93	−0.7	6	6,254	sw.	30	sw.	30	6	11	14	6.5	0.0	0.0
Walla Walla	991	87	65	28.92	29.99	+ .03	56.8	−3.9	86	3	68	36	25	46	34		46	35	49	0.68	−1.2	7	4,853	s.	24	nw.	20	14	9	8	4.6	0.0	0.0
North Pacific Coast Region.							52.3	−1.5											74	1.55	−1.2										6.3		
North Head	211	11	56	29.89	30.12	+0.09	49.4	−1.8	63	2	52	42	8	46	14		48	46	90	1.66	−0.7	16	11,070	nw.	44	nw.	7	5	10	16	7.0	0.0	0.0
North Yakima	1,071	4	....				57.0	.....	86	28	72	31	19	42	40		.....	.....	.....	0.65	.....	5	.....	nw.	.....	.....	.....	21	4	6	....	0.0	0.0
Port Angeles	29	8	53	30.06	30.09	.....	50.1	.....	70	26	58	37	25	42	31		.....	.....	.....	0.46	−0.8	8	6,340	nw.	36	nw.	30	6	19	6	5.2	0.0	0.0
Seattle	125	215	250	29.96	30.09	+ .08	52.4	−2.6	72	27	60	39	8	45	25		47	42	72	1.19	−1.1	12	6,667	s.	34	sw.	19	3	13	15	6.8	0.0	0.0
Tacoma	213	113	120	29.86	30.09	+ .07	53.1	−1.4	76	28	62	40	27	44	30		47	41	69	1.23	−1.3	11	5,232	sw.	26	sw.	7	4	14	13	6.8	0.0	0.0
Tatoosh Island	86	7	57	29.99	30.09	+ .08	48.8	−0.8	61	9	53	42	24	45	14		46	44	85	2.08	−2.0	12	8,402	w.	46	s.	3	10	7	14	5.9	0.0	0.0
Medford	1,425	4	....				54.4	.....	85	1	70	30	21	39	48		.....	.....	.....	.....	.....	3	.....	nw.	.....	.....	.....	12	10	9	....	0.0	0.0
Portland, Oreg.	153	68	106	29.93	30.09	+ .06	55.6	−1.2	79	2	64	40	21	47	28		48	41	63	1.38	−1.0	12	4,320	nw.	24	sw.	18	7	12	12	6.2	0.0	0.0
Roseburg	510	9	57	29.55	30.11	+ .08	54.8	−1.2	82	29	67	34	21	42	40		47	40	64	1.34	−0.7	11	2,827	n.	17	nw.	26	10	18	3	4.3	0.0	0.0
Middle Pacific Coast Region.							54.3	−1.8											73	0.06	−1.2										3.0		
Eureka	62	73	89	30.05	30.12	+0.07	50.6	−1.5	69	2	55	41	21	46	23		47	45	84	0.29	−2.2	4	6,653	n.	33	n.	24	9	15	7	5.0	0.0	0.0
Mount Tamalpais	2,375	11	18	27.51	29.98	− .02	52.6	−1.1	79	1	60	36	26	45	27		44	35	58	0.01	−1.5	1	14,808	nw.	88	nw.	4	22	7	2	2.3	0.0	0.0
Point Reyes Light	490	7	18	29.44	29.96	.....	49.2	−2.4	61	2	53	43	5	46	16		.....	.....	.....	T.	.....	0	23,237	nw.	70	nw.	5	14	10	7	4.5	0.0	0.0
Red Bluff	332	50	56	††																													
Sacramento	69	106	117	29.87	29.94	.00	61.8	−1.1	92	1	76	42	26	48	38		52	44	60	0.01	−1.0	1	6,855	s.	28	sw.	7	28	3	0	1.0	0.0	0.0
San Francisco	155	209	213	29.84	30.01	+ .02	54.6	−0.9	76	2	61	46	3	48	29		49	46	79	T.	−0.8	0	9,246	sw.	32	sw.	28	20	11	0	2.3	0.0	0.0
San Jose	141	12	110	29.87	30.02	.....	57.0	−3.7	83	2	70	38	14	44	38		.....	.....	.....	T.	−0.7	0	5,276	nw.	25	nw.	4	22	7	2	2.6	0.0	0.0
South Pacific Coast Region.							60.4	−1.1											67	0.23	−0.4										3.9		
Fresno	327	89	98	29.50	29.94	+0.02	63.8	−4.6	92	1	78	44	10	50	36		51	39	48	0.51	−0.1	2	6,606	nw.	27	nw.	4	25	5	1	1.5	0.0	0.0
Los Angeles	338	159	191	29.61	29.98	+ .03	61.2	+0.7	87	2	69	48	10	53	31		54	50	73	0.40	−0.1	3	4,434	sw.	20	sw.	27	9	16	6	5.1	0.0	0.0
San Diego	87	62	70	29.89	29.98	+ .03	60.8	0.0	73	1	65	49	11	56	17		54	50	71	T.	−0.4	0	5,325	sw.	22	nw.	12	12	14	5	4.7	0.0	0.0
San Luis Obispo	201	32	40	29.82	30.04	+ .04	55.8	−0.9	88	1	66	37	9	45	40		48	44	75	0.01	−0.9	1	3,675	w.	19	sw.	26	18	9	4	3.4	0.0	0.0
West Indies.																																	
San Juan, P. R.	82	8	54	29.90	29.98	−0.01	76.8	.....	84	1	81	69	1	73	15		.....	.....	.....	4.31	−0.4	15	11,953	ne.	39	ne.	13	6	14	11	6.0	0.0	0.0
Panama Canal.																																	
Balboa Heights	118	7	97	29.70	29.82	−0.02	80.6	+0.1	90	27	87	71	13	74	16		76	75	89	6.75	−1.9	21	4,863	n.	28	n.	14	0	16	15	7.3	0.0	0.0
Colon	36	30	97	29.79	29.83	−0.02	79.6	−0.6	89	31	84	72	18	76	13		76	75	86	19.26	+6.6	25	7,238	n.	26	ne.	4	0	8	23	8.4	0.0	0.0
Alaska.																																	
Juneau	80	11	49	.....	.....	.....	45.8	−2.8	68	10	55	31	18	37	32		42	36	71	5.59	.....	15	2,789	s.	18	w.	11	12	5	14	5.6	0.0	0.0

†† Report missing.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during May, 1918, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex.	17			2.10														0.67			
Albany, N. Y.	10			0.36														0.34			
Alpena, Mich.	31	6:25 a. m.	9:40 a. m.	0.69	8:56 a. m.	9:09 a. m.	0.13	0.12	0.34	0.51											
		12:20 p. m.	2:02 p. m.	0.89	1:36 p. m.	1:59 p. m.	0.11	0.10	0.27	0.51	0.63	0.78									
Amarillo, Tex.	30			0.81														0.33			
Anniston, Ala.	13			1.11														0.56			
Asheville, N. C.	28			1.49														1.48			
Atlanta, Ga.	13			1.22														0.72			
Atlantic City, N. J.	27–28	8:50 p. m.	3:00 a. m.	1.66	12:23 a. m.	12:48 a. m.	0.93	0.17	0.36	0.46	0.52	0.61									
Augusta, Ga.	15			0.61														0.50			
Baker, Oreg.	14			0.02														0.01			
Baltimore, Md.	10	4:35 p. m.	5:50 p. m.	0.77	4:54 p. m.	5:26 p. m.	0.10	0.12	0.21	0.23	0.37	0.51	0.63	0.66							
Bentonville, Ark.	11			2.17														0.50			
Binghamton, N. Y.	12	7:15 p. m.	10:00 p. m.	2.16	8:20 p. m.	9:16 p. m.	0.10	0.06	0.10	0.22	0.51	0.85	1.09	1.31	1.43	1.65	1.82	2.05			
Birmingham, Ala.	12–13	D. N. p. m.	9:23 a. m.	3.86	2:47 a. m.	4:28 a. m.	1.02	0.05	0.11	0.22	0.37	0.47	0.55	0.63	0.77	0.89	0.94	1.17	1.75	2.07	2.14
Bismarck, N. Dak.	18			0.31														0.25			
Block Island, R. I.	25			0.76														0.59			
Boise, Idaho.	27			0.92														0.21			
Boston, Mass.	1			1.05														0.39			
Buffalo, N. Y.	26			0.52														0.36			
Burlington, Vt.	20	5:42 p. m.	6:10 p. m.	0.68	5:42 p. m.	6:02 p. m.	0.00	0.27	0.56	0.57	0.67										
Cairo, Ill.	7	7:35 a. m.	11:10 a. m.	0.82	10:00 a. m.	10:17 a. m.	0.17	0.28	0.55	0.60	0.64										
Canton, N. Y.	12			1.17														0.46			
Charles City, Iowa.	9	2:43 p. m.	7:45 p. m.	1.27	6:29 p. m.	6:59 p. m.	0.64	0.07	0.20	0.26	0.38	0.47	0.56								
Charleston, S. C.	15	10:30 a. m.	2:15 p. m.	1.22	10:38 a. m.	11:27 a. m.	0.04	0.10	0.23	0.34	0.38	0.49	0.52	0.64	0.72	0.79	0.88				
	16	3:08 p. m.	9:30 p. m.	1.46	5:16 p. m.	6:05 p. m.	0.44	0.09	0.13	0.21	0.37	0.53	0.71	0.80	0.84	0.92	0.97				
Charlotte, N. C.	20			0.64														0.58			
Chattanooga, Tenn.	13			1.86														0.37			
Cheyenne, Wyo.	27–28			0.72														*			
Chicago, Ill.	28			1.59														0.46			
Cincinnati, Ohio.	12			1.81														0.57			
Cleveland, Ohio.	22	2:25 p. m.*	2:59 p. m.	0.88	2:30 p. m.	2:59 p. m.	0.01	0.28	0.62	0.69	0.75	0.81	0.87								
Columbia, Mo.	22			1.77														0.68			
Columbia, S. C.	19			0.39														0.39			
Columbus, Ohio.	7			0.81														0.50			
Concord, N. H.	13			0.43														0.29			
Concordia, Kans.	25	7:07 p. m.	11:41 p. m.	0.72	7:10 p. m.	7:30 p. m.	0.01	0.14	0.18	0.47	0.60										
Corpus Christi, Tex.	4	7:24 a. m.	4:40 p. m.	1.59	10:40 a. m.	11:14 a. m.	0.09	0.07	0.22	0.41	0.46	0.63	0.96	1.12							
Dallas, Tex.	17	2:25 p. m.	9:32 p. m.	2.09	2:38 p. m.	3:42 p. m.	0.04	0.11	0.23	0.65	0.85	0.96	0.99	1.05	1.20	1.29	1.36	1.45	1.63		
Davenport, Iowa.	24			2.02														0.62			
Dayton, Ohio.	12			2.66														0.62			
Del Rio, Tex.	4	Midnight.	8:45 a. m.	1.78	6:56 a. m.	7:54 a. m.	0.55	0.15	0.32	0.40	0.54	0.65	0.70	0.72	0.74	0.87	1.00	1.12			
Denver, Colo.	10–11			0.99														*			
Des Moines, Iowa.	24	2:40 a. m.	8:25 a. m.	1.86	7:01 a. m.	7:27 a. m.	0.91	0.14	0.17	0.22	0.39	0.60	0.65								
Detroit, Mich.	10			0.80														0.48			
Devils Lake, N. Dak.	24			0.50														0.34			
Dodge City, Kans.	30			0.73														0.42			
Drexel, Nebr.	21			0.84														0.63			
Dubuque, Iowa.	8–9	5:47 p. m.	6:30 a. m.	1.69	6:08 a. m.	6:20 a. m.	0.98	0.29	0.68	0.71											
Do.	17	1:33 p. m.	4:14 p. m.	0.79	1:37 p. m.	2:02 p. m.	0.01	0.16	0.38	0.46	0.59	0.64									
Do.	17–18	6:10 p. m.	D. N. a. m.	1.54	6:57 p. m.	7:27 p. m.	0.10	0.23	0.45	0.60	0.65	0.72	0.77								
Do.	21	6:40 p. m.	D. N. p. m.	1.43	7:47 p. m.	8:07 p. m.	0.58	0.15	0.42	0.54	0.61										
Duluth, Minn.	24			0.94														0.87			
Eastport, Me.	10			0.26														0.22			
Elkins, W. Va.	7–8	6:40 p. m.	D. N. a. m.	1.33	10:08 p. m.	11:00 p. m.	0.07	0.15	0.34	0.44	0.52	0.65	0.81	0.88	0.93	0.95	1.01	1.08			
Ellendale, N. Dak.	31	6:35 p. m.	D. N. p. m.	1.37	6:44 p. m.	7:19 p. m.	0.02	0.05	0.08	0.45	0.80	0.95	1.06	1.11							
El Paso, Tex.	1			0.05														0.02			
Erie, Pa.	19			0.69														0.53			
Escanaba, Mich.	18			1.56														0.56			
Eureka, Cal.	4			0.13														0.07			
Evansville, Ind.	11			3.12														0.56			
Flagstaff, Ariz.	29			0.01														*			
Fort Smith, Ark.	11	9:06 a. m.	6:25 p. m.	1.93	4:49 p. m.	5:18 p. m.	1.23	0.05	0.12	0.18	0.28	0.48	0.59								
	20	12:57 p. m.	2:04 p. m.	0.59	1:27 p. m.	1:47 p. m.	0.01	0.11	0.22	0.46	0.53										
Fort Wayne, Ind.	29			0.54														0.33			
Fort Worth, Tex.	17			1.89														0.54			
Fresno, Cal.	8			0.38														0.20			
Galveston, Tex.	5			0.15														0.10			
Grand Haven, Mich.	21–22			0.66														0.23			
Grand Junction, Colo.	10			0.03														0.02			
Grand Rapids, Mich.	19	7:10 p. m.	11:45 p. m.	1.18	7:15 p. m.	8:04 p. m.	0.01	0.10	0.19	0.28	0.44	0.50	0.52	0.52	0.54	0.69	0.74				
	25–26	8:40 p. m.	D. N. a. m.	0.78	10:51 p. m.	11:27 p. m.	0.03	0.26	0.34	0.35	0.39	0.46	0.55	0.64	0.67						
Green Bay, Wis.	17–18	9:25 p. m.	8:30 a. m.	1.94	12:08 a. m.	1:04 a. m.	0.32	0.13	0.16	0.25	0.38	0.47	0.52	0.55	0.56	0.58	0.77	0.97			
Do.	19	1:30 p. m.	3:30 p. m.	1.45	2:28 p. m.	2:53 p. m.	0.12	0.23	0.43	0.84	1.20	1.27									
Do.	25	D. N. a. m.	5:10 a. m.	0.86	1:00 a. m.	1:22 a. m.	0.03	0.07	0.26	0.40	0.49	0.53									
Greenville, S. C.	8	6:01 p. m.	10:00 p. m.	2.13	6:11 p. m.	6:37 p. m.	0.01	0.20	0.38	0.56	0.72	0.80	0.82								
					7:48 p. m.	8:08 p. m.	0.97	0.17	0.45	0.58	0.64										
Hannibal, Mo.	19	6:55 p. m.	D. N. p. m.	0.81	7:12 p. m.	7:43 p. m.	0.01	0.21	0.32	0.48	0.61	0.66	0.73	0.77							
Do.	27	12:11 p. m.	2:40 p. m.	1.75	12:34 p. m.	2:00 p. m.	0.03	0.05	0.11	0.17	0.32	0.52	0.71	0.91	1.09	1.28	1.34	1.48	1.59	1.72	
Do.	28	3:47 p. m.	7:05 p. m.	0.67	4:00 p. m.	4:18 p. m.	0.03	0.11	0.28	0.48	0.53										
Harrisburg, Pa.	28	3:58 p. m.	5:05 p. m.	0.66	4:16 p. m.	4:30 p. m.	0.01	0.27	0.52	0.60											
Hartford, Conn.	21	6:35 p. m.	7:40 p. m.	0.63	6:39 p. m.	7:04 p. m.	T.	0.07	0.16	0.26	0.41	0.52									
Hatteras, N. C.	23	9:05 p. m.	10:30 p. m.	0.78	9:07 p. m.	9:43 p. m.	0.01	0.13	0.22	0.31	0.43	0.57	0.61	0.69	0.73						
Havre, Mont.	24			0.04														0.03			
Helena, Mont.	24			0.61														0.10			
Houghton, Mich.	31			2.63														0.70			
Houston, Tex.	4			1.57														0.48			
Huron, S. Dak.	9			1.12														0.45			
Independence, Cal.	28–29			0.16														*			
Indianapolis, Ind.	12			1.50														0.45			
Iola, Kans.	29	4:45 a. m.	8:10 a. m.	1.74	5:03 a. m.	6:01 a. m.	0.04	0.05	0.21	0.35	0.52	0.61	0.66	0.76	0.86	0.95	1.06	1.21			
Jacksonville, Fla.	14	10:30 a. m.	4:20 p. m.	2.02	12:24 p. m.	12:53 p. m.	0.04	0.34	0.77	1.15	1.37	1.49	1.55								
Kalispell, Mont.	20			0.19														*			
Kansas City, Mo.	22	4:40 a. m.	7:25 a. m.	0.68	5:07 a. m.	5:26 a. m.	0.02	0.15	0.19	0.41	0.55										
Keokuk, Iowa.	17	7:00 p. m.	9:02 p. m.	0.89	7:04 p. m.	7:24 p. m.	0.00	0.27	0.43	0.50	0.57										
Do.	27	4:15 p. m.	7:25 p. m.	1.46	5:48 p. m.	6:40 p. m.	0.17	0.09	0.25	0.29	0.35	0.43	0.49	0.59	0.71	1.05	1.16				
Do.	28	5:35 p. m.	11:00 p. m.	0.74	5:55 p. m.	6:10 p. m.	0.02	0.13	0.24	0.51											
Key West, Fla.	29	8:38 a. m.	4:35 p. m.	1.60	11:07 a. m.	11:36 a. m.	0.45	0.13	0.21	0.25	0.44	0.59	0.65								
Knoxville, Tenn.	13	3:10 a. m.	1:55 p. m.	2.95	8:14 a. m.	8:35 a. m.	1.50	0.17	0.30	0.38	0.51	0.55									
Do.	21	4:10 p. m.	5:20 p. m.	0.83	4:11 p. m.	4:39 p. m.	T.	0.25	0.44	0.57	0.68	0.75	0.80								
La Crosse, Wis.	27			0.97														0.54			

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during May, 1918, at all stations, furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.												
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min	100 min.	120 min.
Lander, Wyo	31			0.28														0.27			
Lansing, Mich	25			0.41														0.32			
Lewiston, Idaho	8			0.21														0.06			
Lexington, Ky	11			0.96														0.38			
Lincoln, Nebr	7			0.58														0.58			
Little Rock, Ark	20			0.20														0.20			
Los Angeles, Cal	8			0.22												*		0.16			
Louisville, Ky	11			2.31														0.55			
Ludington, Mich	25–26	D. N. p. m.	6:25 a. m.	1.31	11:47 p. m.	12:35 a. m.	0.03	0.16	0.21	0.22	0.30	0.57	0.68	0.76	0.94	1.03	1.08				
Lynchburg, Va	30			0.42														0.42			
Macon, Ga	13			0.07														0.03			
Madison, Wis	21			0.73														0.44			
Marquette, Mich	17	5:47 p. m.	7:25 p. m.	2.40	5:57 p. m.	6:25 p. m.	1.09	0.42	0.63	0.78	1.00	1.12	1.20	1.42	1.59	1.63	1.83	2.03	2.29	2.43	2.43
Do	31	6:23 p. m.	8:23 p. m.	1.13	6:29 p. m.	6:48 p. m.	0.01	0.48	0.74	0.91	1.06	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.09	1.13	
Memphis, Tenn	12			0.54														0.46			
Meridian, Miss	12–13	7:30 p. m.	4:15 a. m.	1.63	9:08 p. m.	9:36 p. m.	0.10	0.08	0.13	0.19	0.31	0.46	0.52								
Miami, Fla	2	D. N. a. m.	D. N. a. m.	1.18	2:06 a. m.	2:46 a. m.	0.08	0.23	0.51	0.58	0.64	0.75	0.87	0.93	1.01						
Milwaukee, Wis	19	4:50 p. m.	6:15 p. m.	0.91	5:01 p. m.	5:17 p. m.	0.07	0.22	0.41	0.61	0.65										
Minneapolis, Minn	31			0.59														0.45			
Mobile, Ala	12–13	D. N. p. m.	10:55 a. m.	2.22	5:37 a. m.	6:34 a. m.	0.18	0.13	0.30	0.51	0.92	1.09	1.24	1.36	1.53	1.68	1.81	1.93			
Modena, Utah	8			0.33														0.18			
Montgomery, Ala	13			1.20														0.37			
Moorhead, Minn	18			0.97														0.57			
Mount Tamalpais, Cal	8			0.01														0.01			
Nantucket, Mass	1			0.51														0.19			
Nashville, Tenn	18	11:22 a. m.	12:35 p. m.	0.65	11:24 a. m.	11:48 a. m.	0.01	0.10	0.26	0.41	0.53	0.57									
New Haven, Conn	1			1.34														0.51			
New Orleans, La	16	10:40 a. m.	2:10 p. m.	1.61	1:02 p. m.	1:44 p. m.	0.46	0.30	0.58	0.65	0.70	0.72	0.88	1.00	1.07	1.10					
New York, N. Y	21			1.30														0.56			
Norfolk, Va	23	3:42 p. m.	4:43 p. m.	0.62	3:50 p. m.	4:16 p. m.	0.01	0.08	0.21	0.31	0.38	0.54	0.56								
Northfield, Vt	13–14			0.90														*			
North Head, Wash	4			0.15														0.14			
North Platte, Nebr	26			0.71														0.40			
Oklahoma, Okla	5	6:15 p. m.	10:10 p. m.	3.62	6:46 p. m.	7:21 p. m.	0.08	0.10	0.44	0.66	1.16	1.41	1.57	1.76							
					8:00 p. m.	8:35 p. m.	1.90	0.41	0.52	0.70	0.93	1.11	1.21	1.31							
Do	17	2:20 a. m.	5:33 a. m.	1.03	2:33 a. m.	2:58 a. m.	0.05	0.16	0.34	0.46	0.54	0.64									
Do	19	7:20 p. m.	11:20 p. m.	1.43	7:56 p. m.	8:41 p. m.	0.03	0.10	0.18	0.24	0.31	0.41	0.49	0.69	0.86	0.96					
Omaha, Nebr	26–27	7:45 p. m.	5:35 a. m.	1.30	1:44 a. m.	1:56 a. m.	0.50	0.13	0.52	0.58											
Oswego, N. Y	20	1:16 p. m.	2:25 p. m.	0.76	1:18 p. m.	1:43 p. m.	T.	0.05	0.25	0.38	0.58	0.65									
	22	3:48 p. m.	8:18 p. m.	0.83	5:26 p. m.	5:46 p. m.	0.11	0.09	0.10	0.22	0.68										
Palestine, Tex	5			0.73														0.36			
Parkersburg, W. Va	25			0.67														0.54			
Pensacola, Fla	13			1.14														0.55			
Peoria, Ill	19			0.61														0.30			
Philadelphia, Pa	22	D. N. a. m.	5:30 a. m.	1.09	3:36 a. m.	4:07 a. m.	0.14	0.08	0.11	0.15	0.23	0.43	0.76								
	27–28	7:35 p. m.	D. N. a. m.	3.16	7:38 p. m.	8:45 p. m.	0.01	0.12	0.14	0.32	0.62	0.68	0.74	0.77	0.82	0.87	0.93	1.08	1.28		
					10:18 p. m.	11:33 p. m.	1.53	0.09	0.17	0.20	0.24	0.35	0.58	0.78	0.89	1.04	1.12	1.17	1.62		
Phoenix, Ariz	3			T.														T.			
Pierre, S. Dak	30			0.85														0.52			
Pittsburgh, Pa	22			0.51														0.41			
Pocatello, Idaho	8			0.17														0.16			
Point Reyes Light, Cal	28			T.														T.			
Port Angeles, Wash	23			0.12														0.12			
Port Huron, Mich	26	D. N. a. m.	6:20 a. m.	1.70	3:57 a. m.	5:24 a. m.	0.30	0.24	0.35	0.37	0.42	0.48	0.52	0.60	0.68	0.79	0.90	0.93	1.23	1.39	
Portland, Me	1			0.79														0.22			
Portland, Oreg	14			0.68														0.18			
Providence, R. I	1			1.13														0.49			
Pueblo, Colo	28			0.03														0.03			
Raleigh, N. C	10–11	11:30 p. m.	12:22 a. m.	0.65	11:42 p. m.	12:12 a. m.	0.01	0.25	0.29	0.32	0.40	0.44	0.59								
	13–14	7:55 p. m.	8:40 a. m.	2.39	8:55 p. m.	9:18 p. m.	0.01	0.15	0.26	0.43	0.51	0.57									
Rapid City, S. Dak	23			0.49														0.49			
Reading, Pa	27	10:00 p. m.	11:30 p. m.	1.08	10:17 p. m.	10:27 p. m.	0.06	0.50	0.98												
Red Bluff, Cal	††			††																	
Reno, Nev	30			0.16														0.09			
Richmond, Va	13			1.49														0.33			
Rochester, N. Y	19			0.26														0.24			
Roseburg, Oreg	9			0.51														0.20			
Roswell, N. Mex	4			0.49														0.39			
Sacramento, Cal	8			0.01														0.01			
Saginaw, Mich	25			0.50														0.39			
St. Joseph, Mo	21–22	10:27 p. m.	9:50 a. m.	2.06	11:11 p. m.	11:51 p. m.	0.11	0.08	0.28	0.43	0.48	0.56	0.62	0.69	0.77						
St. Louis, Mo	11			1.65														0.33			
St. Paul, Minn	30–31	11:40 a. m.	12:45 a. m.	0.90	11:40 p. m.	12:07 a. m.	0.00	0.18	0.47	0.62	0.70	0.77	0.81								
Salt Lake City, Utah	29–30			0.50														0.19			
San Antonio, Tex	4–5	6:01 p. m.	6:28 a. m.	2.19	7:00 p. m.	7:40 p. m.	0.05	0.18	0.45	0.69	0.89	1.03	1.09	1.16	1.23						
San Diego, Cal	8			T.														T.			
Sand Key, Fla	29–30			1.38														0.56			
Sandusky, Ohio	25	8:30 p. m.	D. N. p. m.	1.36	8:44 p. m.	10:00 p. m.	0.02	0.15	0.16	0.18	0.28	0.52	0.74	0.87	0.93	0.93	0.95	1.06	1.33		
	30	1:05 p. m.	4:15 p. m.	0.62	2:36 p. m.	2:55 p. m.	0.03	0.10	0.28	0.43	0.56										
Sandy Hook, N. J	10			0.32														0.31			
San Francisco, Cal	7–8			T.														T.			
San Jose, Cal	8			T.														T.			
San Luis Obispo, Cal	8			0.01														T.			
Santa Fe, N. Mex	4			1.00														0.22			
Sault Ste. Marie, Mich	19–20			0.97														0.68			
Savannah, Ga	16	2:32 p. m.	4:15 p. m.	0.69	3:11 p. m.	3:33 p. m.	0.06	0.06	0.19	0.24	0.50	0.55									
Scranton, Pa	20			0.90						*								0.46			
Seattle, Wash	8			0.23														0.10			
Sheridan, Wyo	8–9			1.15														*			
Shreveport, La	12			0.41														0.37			
Sioux City, Iowa	17			0.88														0.52			
Spokane, Wash	16			0.25														0.11			
Springfield, Ill	9	D. N. a. m.	D. N. a. m.	2.16	1:29 a. m.	2:16 a. m.	0.17	0.07	0.24	0.58	0.86	1.04	1.23	1.44	1.59	1.65	1.71				
Springfield, Mo	11			1.88														0.51			
Syracuse, N. Y	25			0.62														0.48			
Tacoma, Wash	8			0.33														0.11			
Tampa, Fla	20	3:15 p. m.	4:50 p. m.	1.36	3:25 p. m.	4:27 p. m.	0.02	0.20	0.26	0.28	0.29	0.38	0.52	0.60	0.73	0.89	1.03	1.27	1.34		
Tatoosh Island, Wash	4			0.63														0.31			
Taylor, Tex	11–12	11:00 p. m.	2:00 a. m.	0.90	11:40 p. m.	12:02 a. m.	0.18	0.05	0.14	0.32	0.62	0.66									
Terre Haute, Ind	9			0.88														0.53			

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month. †† Report missing.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during May, 1918, at all stations furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Thomasville, Ga.	14			0.82														0.60			
Toledo, Ohio	30			0.31														0.27			
Tonopah, Nev.	10			0.25														*			
Topeka, Kans.	22	4:00 a.m.	5:10 p.m.	0.55	4:04 a.m.	4:19 a.m.	0.01	0.21	0.41	0.47	0.51										
Do.	28–29	6:45 p.m.	7:20 a.m.	4.28	10:33 p.m.	11:44 p.m.	0.25	0.20	0.42	0.43	0.45	0.50	0.54	0.58	0.71	0.79	0.94	1.33	1.91		
Do.	28–29	6:45 p.m.	7:20 a.m.	4.28	1:04 a.m.	2:10 a.m.	2.25	0.09	0.16	0.34	0.54	0.66	0.72	0.79	0.83	0.86	0.93	1.07	1.26		
Trenton, N. J.	21–22	2:15 p.m.	D. N. a.m.	1.99	2:19 p.m.	2:40 p.m.	0.01	0.23	0.41	0.47	0.57	0.58									
Valentine, Nebr.	30			0.19														0.18			
Vicksburg, Miss.	12			0.73														0.41			
Walla Walla, Wash.	15			0.28														0.10			
Washington, D. C.	13			1.00														0.75			
Wausau, Wis.	25–26	D. N. p.m.	D. N. a.m.	1.54	12:57 a.m.	1:26 a.m.	0.60	0.06	0.08	0.15	0.51	0.71	0.85								
Wichita, Kans.	5–6	7:50 p.m.	5:30 a.m.	1.37	1:33 a.m.	2:00 a.m.	0.11	0.07	0.12	0.17	0.29	0.48	0.53								
	29	D. N. a.m.	6:10 a.m.	1.62	1:48 a.m.	2:48 a.m.	0.09	0.12	0.28	0.31	0.36	0.46	0.52	0.58	0.76	0.93	1.14	1.38			
Williston, N. Dak.	6			0.33														0.28			
Wilmington, N. C.	8	2:03 p.m.	7:30 p.m.	0.94	2:18 p.m.	2:58 p.m.	0.01	0.08	0.12	0.15	0.22	0.36	0.52	0.55	0.65						
Winnemucca, Nev.	27			0.21														0.06			
Wytheville, Va.	13			0.93														0.37			
Yankton, S. Dak.	18	6:42 p.m.	7:45 p.m.	1.43	6:47 p.m.	7:15 p.m.	0.02	0.15	0.27	0.43	0.76	1.08	1.27								
Do.	20–21	8:50 p.m.	6:55 a.m.	1.91	10:25 p.m.	11:10 p.m.	0.26	0.08	0.18	0.36	0.47	0.52	0.60	0.65	0.68	0.76					
Do.	28	8:10 a.m.	7:10 p.m.	1.91	2:52 p.m.	3:47 p.m.	0.64	0.06	0.13	0.19	0.31	0.37	0.46	0.57	0.62	0.76	0.97	1.09			
Yellowstone Park, Wyo.	5			0.35														*			

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE III.—*Data furnished by the Canadian Meteorological Service, May, 1918.*

Stations.	Altitude above M. S. L.* Jan. 1916.	Pressure.			Temperature.						Precipitation.		
		Station reduced to mean of 24 hours.	Sea-level reduced to mean of 24 hours.	Departure from normal.	Mean max.+ mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Feet.	*Inches.*	*Inches.*	*Inches.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	*Inches.*	*Inches.*	*Inches.*
St. Johns, N. F.	125	29.82	29.96	−0.02	45.2	+2.3	54.8	35.7	75	28	1.58	−2.08	1.0
Sydney, C. B. I.	48	30.00	30.04	+ .07	48.5	+3.3	59.6	37.3	84	28	0.88	−2.89	0.0
Halifax, N. S.	88	29.94	30.05	+ .07	51.9	+3.5	63.0	40.9	85	28	1.05	−3.21	0.0
Yarmouth, N. S.	65	29.97	30.04	+ .06	48.8	+1.2	56.1	41.5	71	33	1.62	−2.18	0.0
Charlottetown, P. E. I.	38	29.96	30.00	+ .04	49.7	+2.8	58.7	40.7	81	28	1.85	−1.06	0.0
Chatham, N. B.	28	29.96	29.98	+0.03	52.7	+4.2	63.5	42.0	88	32	2.78	−0.43	0.0
Father Point, Que.	20	29.94	29.96	+ .03	44.4	+0.4	52.5	36.3	68	27	4.53	+1.95	0.6
Quebec, Que.	296	29.64	29.96	+ .02	53.0	+3.1	63.1	43.0	83	32	4.96	+1.88	T.
Montreal, Que.	187	29.76	29.96	+ .02	58.9	+4.2	68.6	49.3	84	34	3.11	+0.16	0.0
Stonecliffe, Ont.	489	29.35	29.96	+ .03	54.5	+2.2	68.4	40.6	90	24	1.06	−1.45	0.0
Ottawa, Ont.	236	29.72	30.04	+0.10	57.7	+2.8	69.1	46.3	86	29	1.75	−0.84	0.0
Kingston, Ont.	285	29.70	30.01	+ .05	54.5	+1.6	64.1	45.0	75	30	3.07	+0.39	0.0
Toronto, Ont.	379	29.60	30.00	+ .02	57.1	+3.9	68.6	45.7	82	30	2.64	−0.40	0.0
White River, Ont.	1,244	28.60	29.92	− .03	45.1	−0.6	56.9	33.4	82	14	2.89	+0.94	0.0
Port Stanley, Ont.	592	29.39	30.03	+ .06	56.1	+3.0	65.2	47.1	81	29	2.79	−0.39	0.0
Southampton, Ont.	656	29.28			53.5	+2.8	64.5	42.6	83	27	2.26	−0.18	0.0
Parry Sound, Ont.	688	29.31	30.01	+0.06	53.0	+1.9	63.9	42.2	82	26	3.72	+0.79	0.0
Port Arthur, Ont.	644	29.21	29.92	− .04	44.9	−1.0	53.6	36.3	66	23	3.49	+1.34	0.0
Winnipeg, Man.	760	29.03	29.86	− .10	49.4	−2.2	62.2	36.7	88	14	0.81	−1.47	0.0
Minnedosa, Man.	1,690	28.06	29.88	− .08	46.8	−1.6	60.7	33.0	88	9	2.38	+0.93	1.9
Qu'Appelle, Sask.	2,115	27.60	29.84	−0.10	47.1	−2.7	60.4	33.9	85	17	1.63	−0.02	6.5
Medicine Hat, Alberta	2,144	27.55	29.82	− .07	53.8	−0.3	69.1	38.5	86	21	0.17	−1.14	0.4
Swift Current, Sask.	2,392	27.26	29.82	− .10	49.7	−1.0	64.9	34.5	84	20	0.42	−1.34	0.4
Calgary, Alberta	3,428	26.37	29.90	+ .02	48.0	−1.0	60.8	35.3	78	23	1.34	−0.43	4.7
Banff, Alberta	4,521	25.30	29.87	− .01	43.7	−3.3	55.6	31.7	69	21	2.91	+0.87	19.4
Edmonton, Alberta	2,150	27.58	29.86	−0.02	47.2	−3.6	58.9	35.5	76	21	1.68	+0.13	9.9
Prince Albert, Sask.	1,450	28.33	29.89	− .06	45.4	−2.2	58.5	32.4	82	22	1.32	+0.06	8.0
Battleford, Sask.	1,592	28.12	29.85	− .07	47.3	−3.7	60.2	34.4	82	23	1.03	−0.59	1.4
Kamloops, B. C.	1,262	28.67	29.95	+ .06	56.8	−2.3	69.3	44.3	84	33	1.12	−0.12	0.0
Victoria, B. C.	230	29.80	30.06	+ .06	52.1	−0.4	59.2	45.0	68	40	0.70	−0.78	0.0
Barkerville, B. C.	4,180	25.66	29.98	+0.14	40.2	−5.3	50.6	29.7	65	23	3.49	+0.97	17.3
Hamilton, Bermuda	151	30.04	30.20	+ .14	70.7	+1.3	76.2	65.1	81	59	0.80	−3.86	0.0

* See explanation of tables, this REVIEW for January, p. 48.

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Chart I. Hydrographs of Several Principal Rivers, May, 1918.

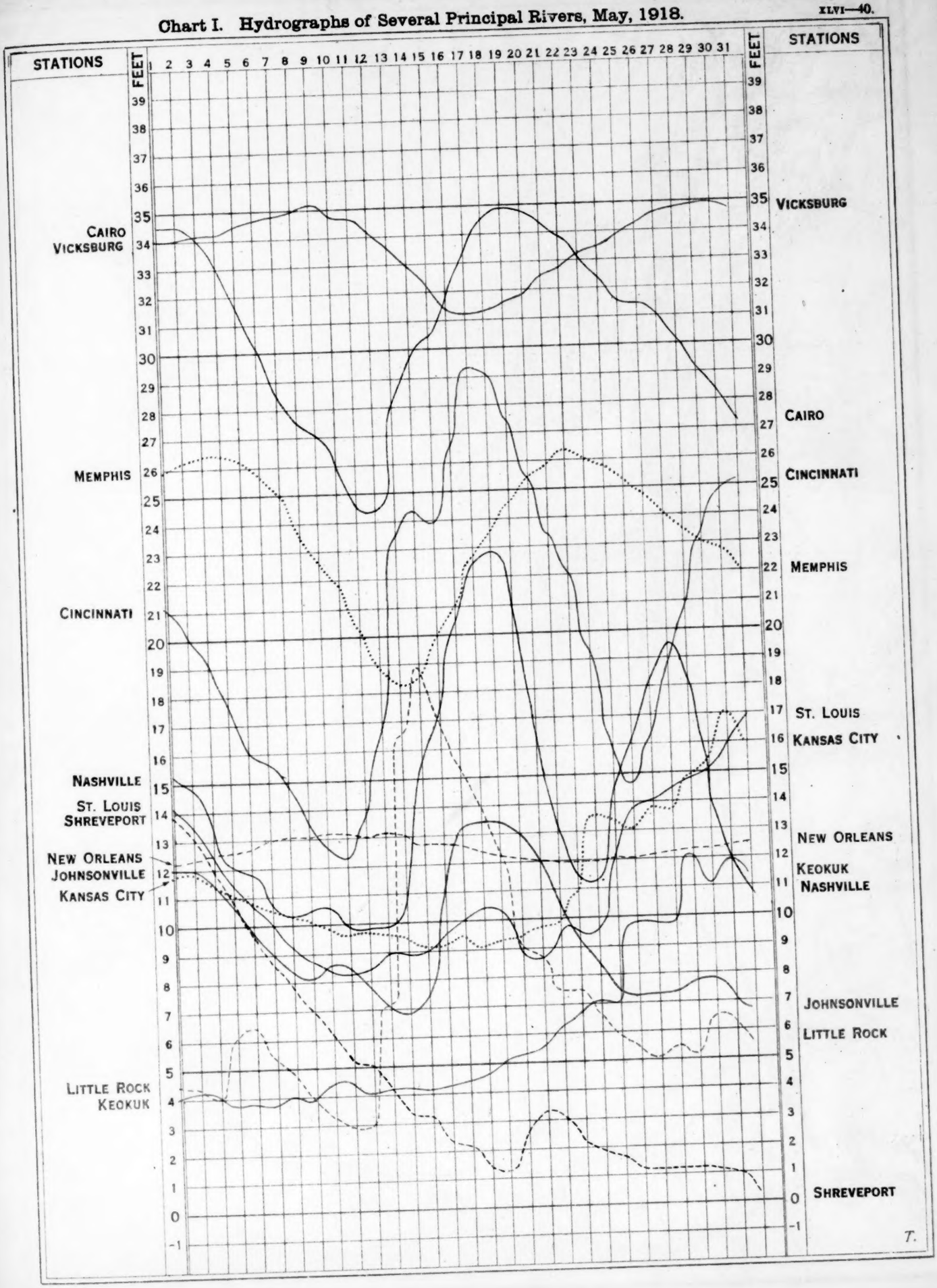


Chart II. Tracks of Centers of High Areas, May, 1918.

(Plotted by Charles A. Donnel.)

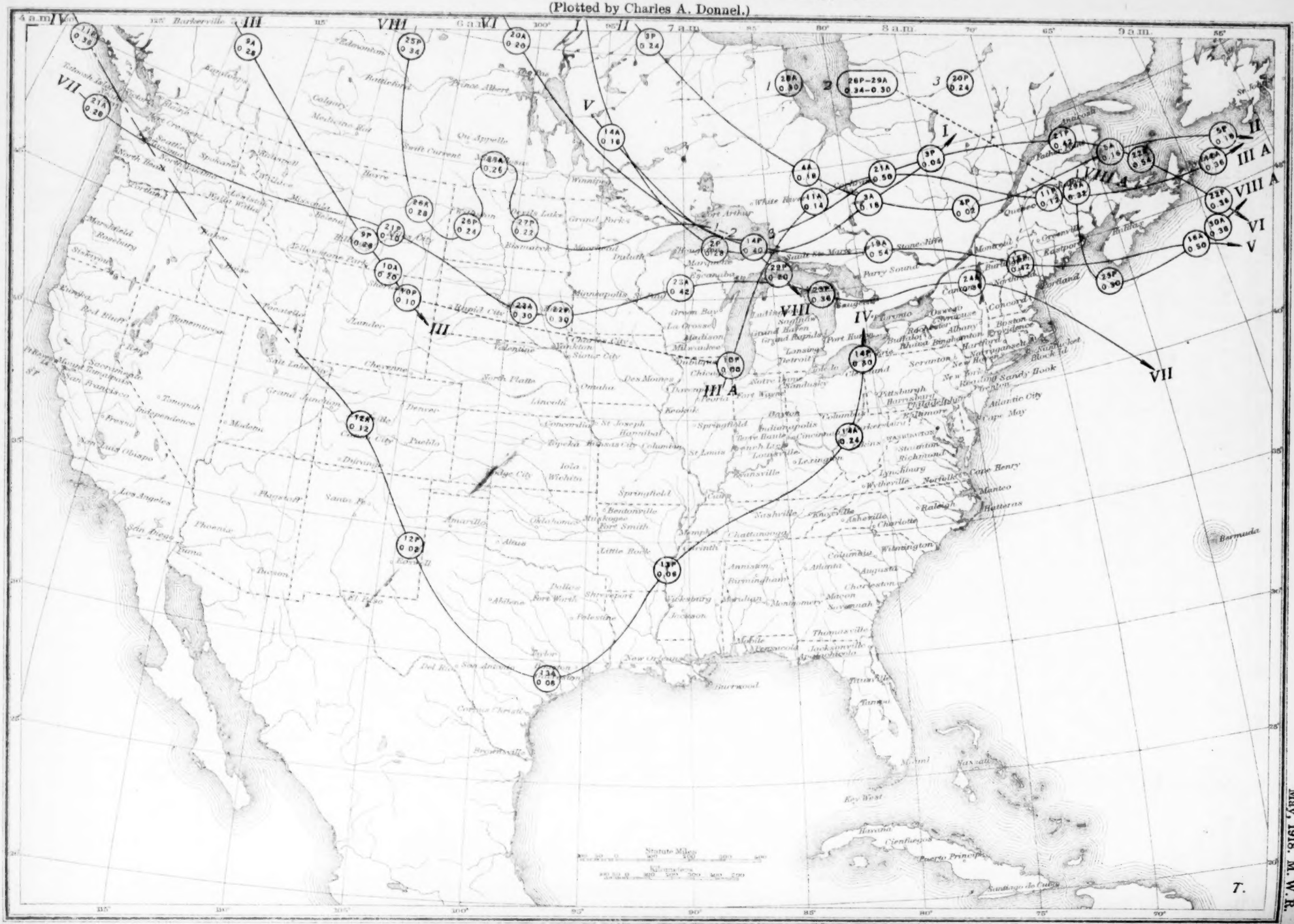


Chart III. Tracks of Centers of Low Areas, May, 1918.

(Plotted by Charles A. Donnel.)

Chart III. Tracks of Centers of Low Areas, May, 1918.

(Plotted by Charles A. Donnel.)

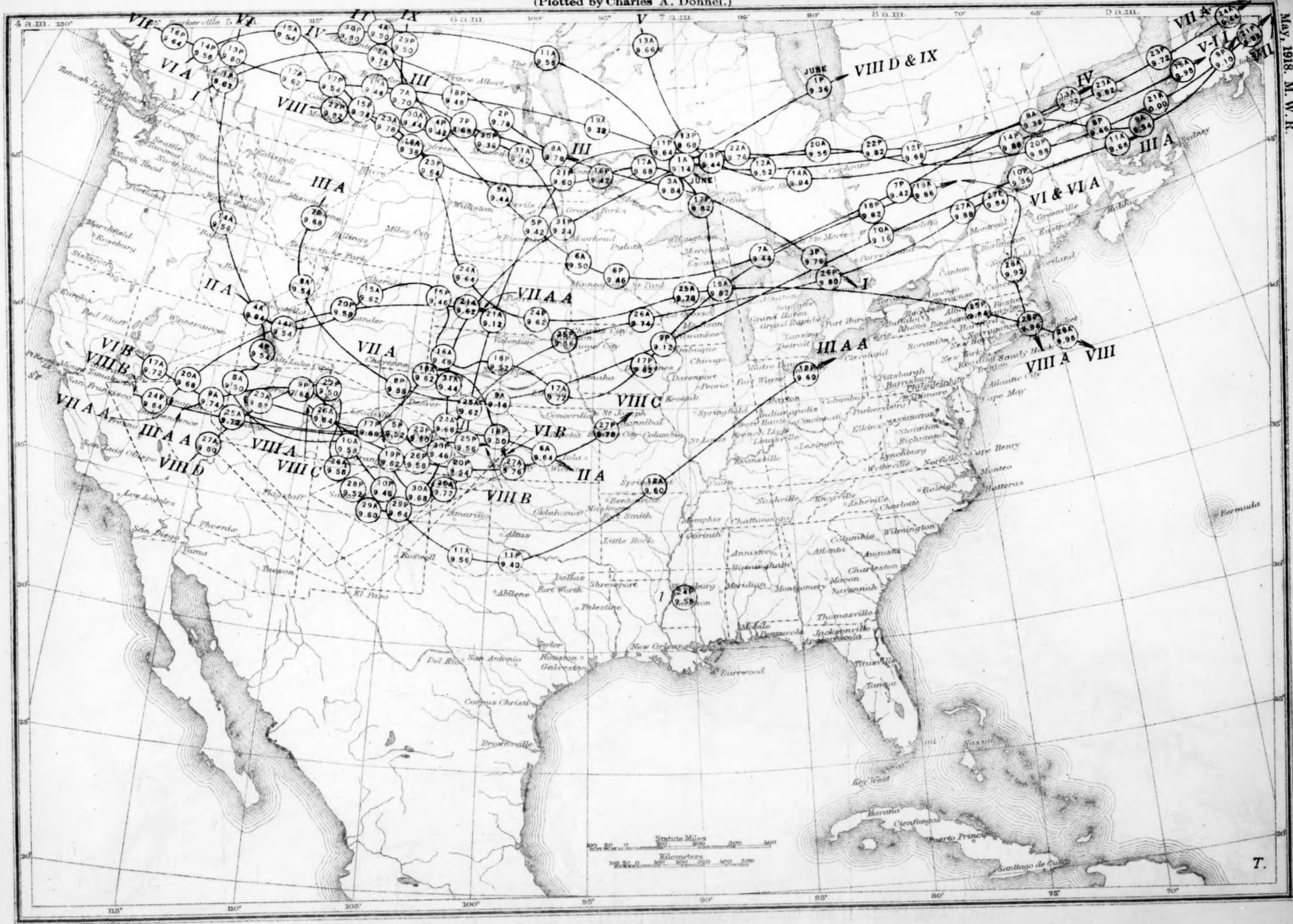


Chart IV. Departure (°F.) of the Mean Temperature from the Normal, May, 1918.

Chart V. Total Precipitation, Inches, May, 1918.

Chart V. Total Precipitation, Inches, May, 1918.

Chart VI. Percentage of Clear Sky between Sunrise and Sunset, May, 1918.

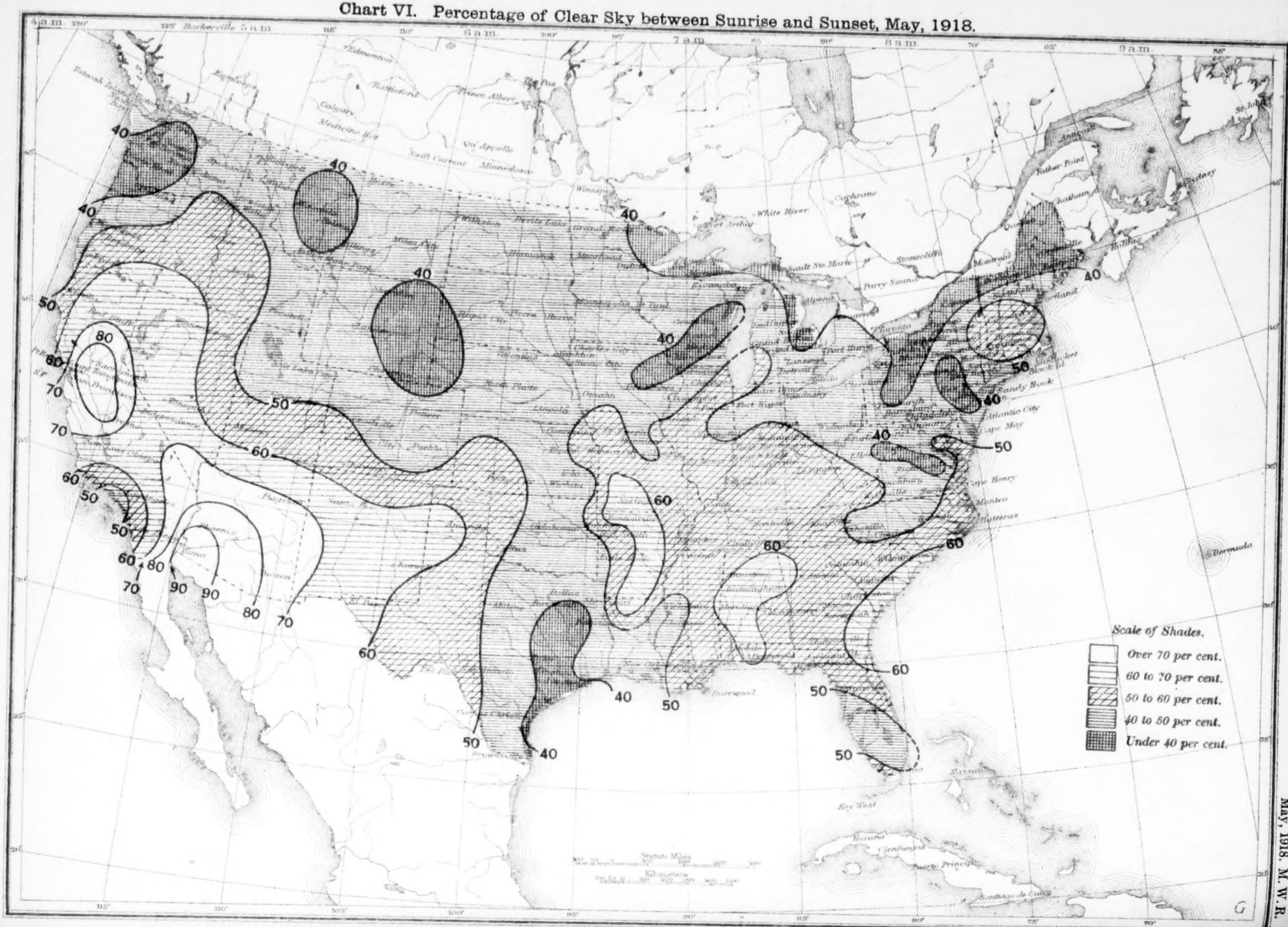


Chart VII. Isobars and Isotherms at Sealevel; Prevailing Winds, May, 1918.

Chart VII. Isobars and Isotherms at Sealevel; Prevailing Winds, May, 1918.

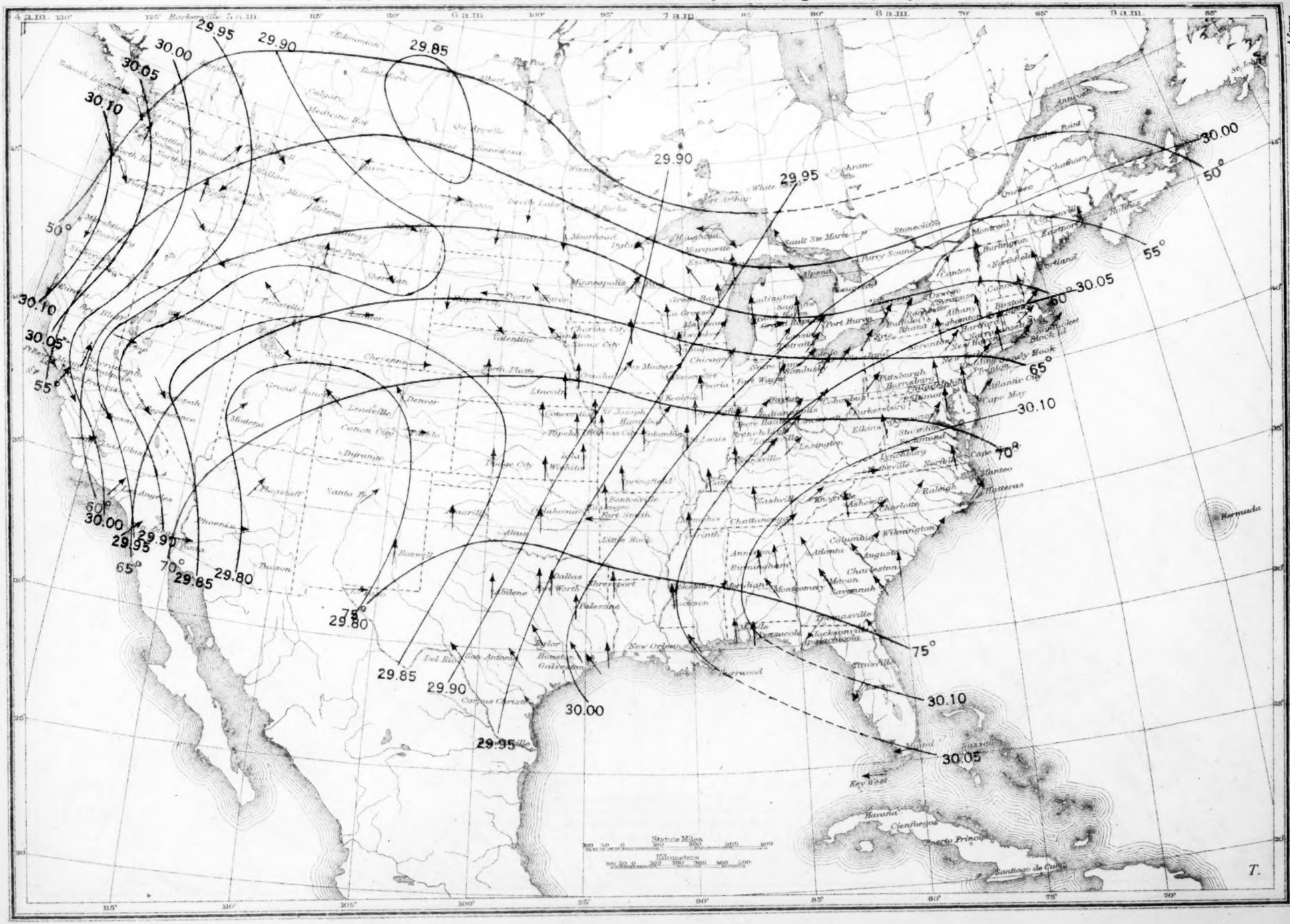
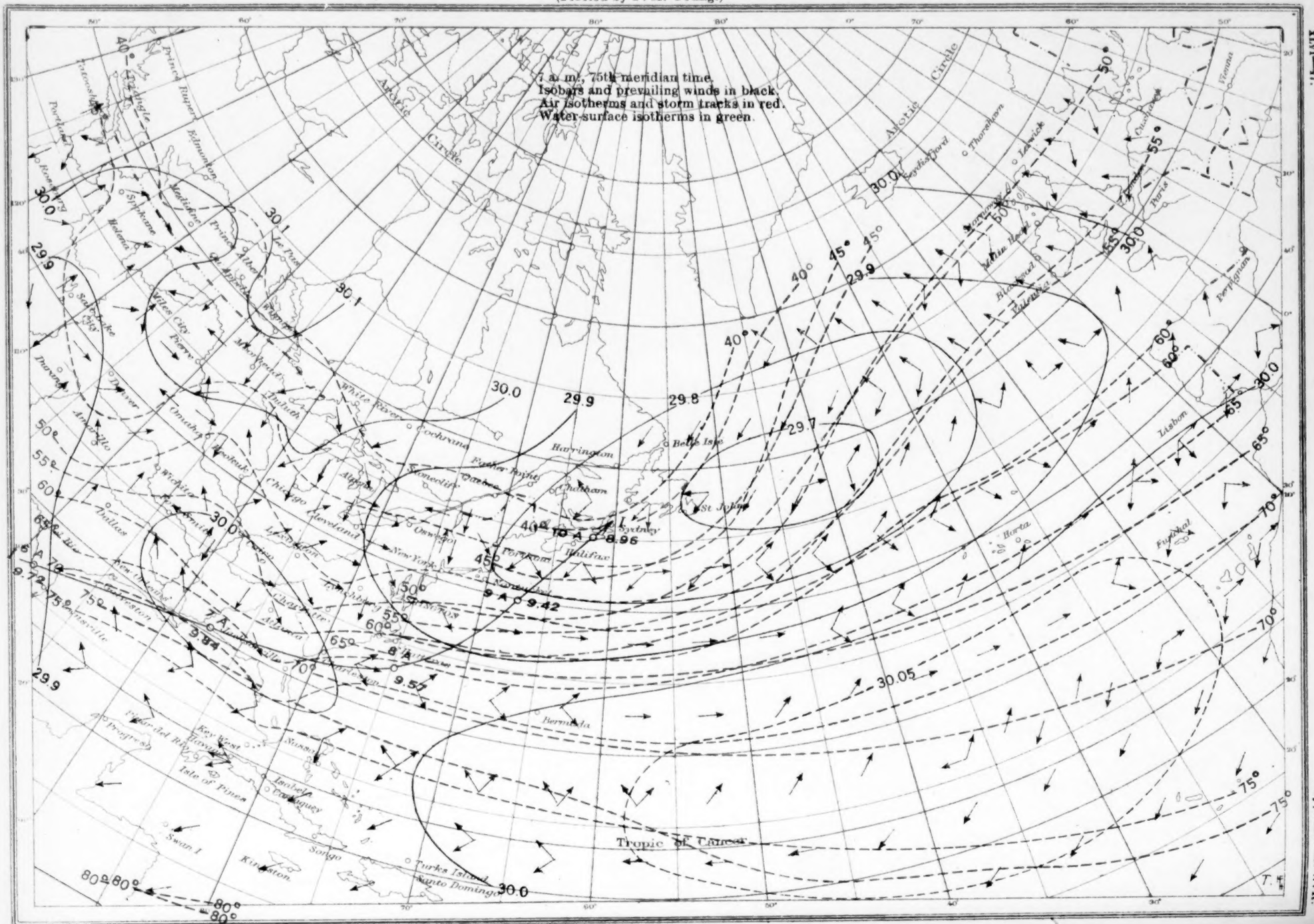


Chart IX. Means of Meteorological Data for North Atlantic Ocean, May, 1917.

(Plotted by F. A. Young.)


7 a. m., 75th meridian time.
Isobars and prevailing winds in black.
Air isotherms and storm tracks in red.
Water-surface isotherms in green.
Arctic Circle
Tropic of Cancer
Bermuda
Belle Isle
St. John's
Halifax
Havrington
Cochrane
White River
Duluth
Minneapolis
Chicago
Cleveland
New York
Portsmouth
Washington
Atlanta
Charleston
Jacksonville
Key West
Havana
Isle of Pines
Swan I.
Kingston
Turks Island
Santo Domingo
Lisbon
Horta
Fayal
Thorshavn
Lerwick
Christiansund
Paris
Portglenone
Valentia
Queenstown
Yarmouth
Sydney
Buffalo
Pittsburg
Omaha
Denver
Amarillo
Dallas
Wichita
Galveston
Montgomery
Tallahassee
Tampa
Nassau
Isabela
Guantanamo
Sorgo
Progreso
Port Simpson
Prince Rupert
Edmonton
Medicine Hat
Swift Current
Prince Albert
Battleford
Qu'Appelle
Winnipeg
Moosonee
Port Arthur
Sault Ste. Marie
Parry Sound
Toronto
Kingston
Ottawa
Montreal
Quebec
Father Point
Sydney
Yarmouth
Boston
Portland
Eastport
Bar Harbor
Block Island
Nantucket
Atlantic City
Baltimore
Norfolk
Hatteras
Wilmington
Charleston
Jacksonville
Tampa
Key West
Havana
Nassau
Isle of Pines
Isabela
Guantanamo
Sorgo
Kingston
Swan I.
Turks Island
Santo Doming